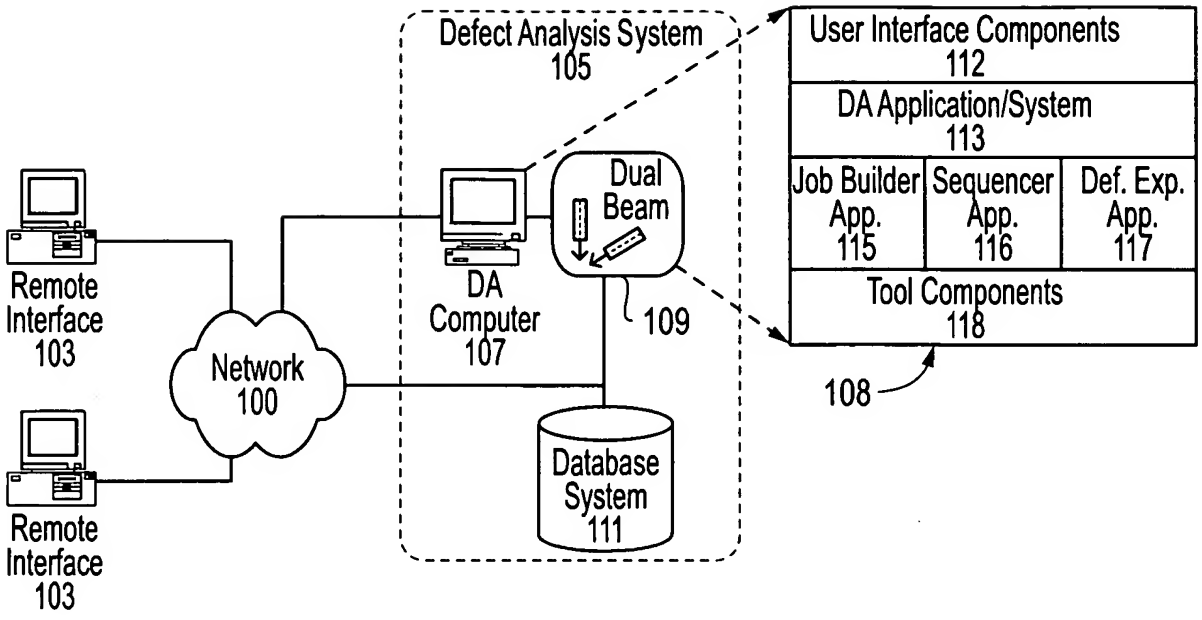


FIG. 1A

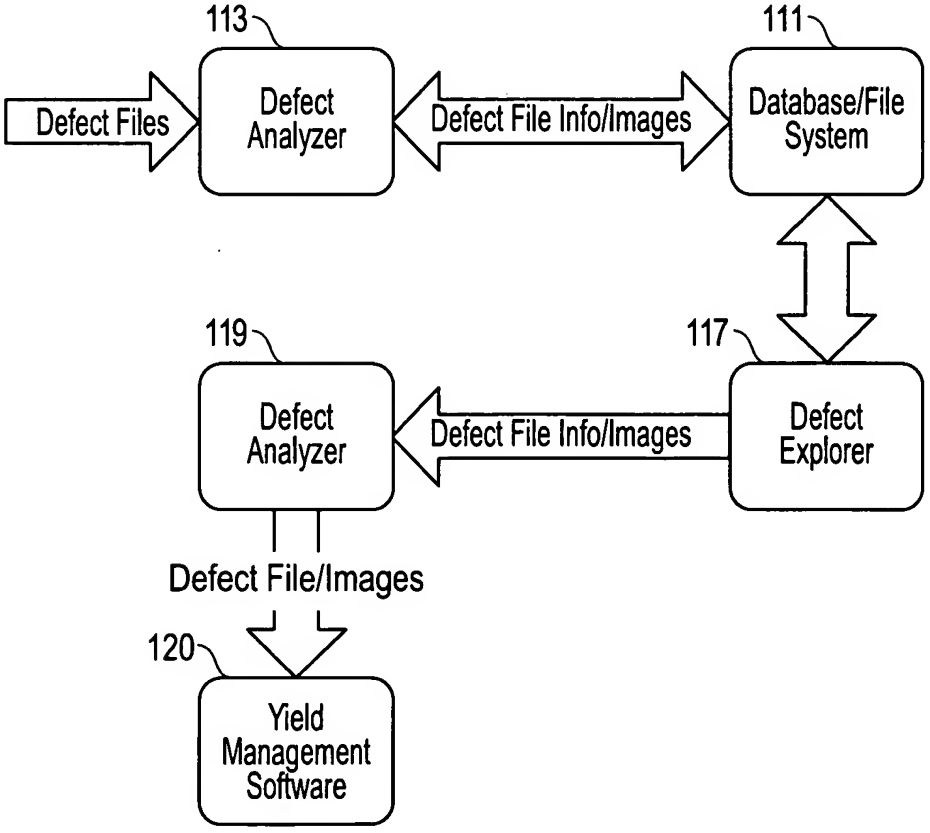


FIG. 1B

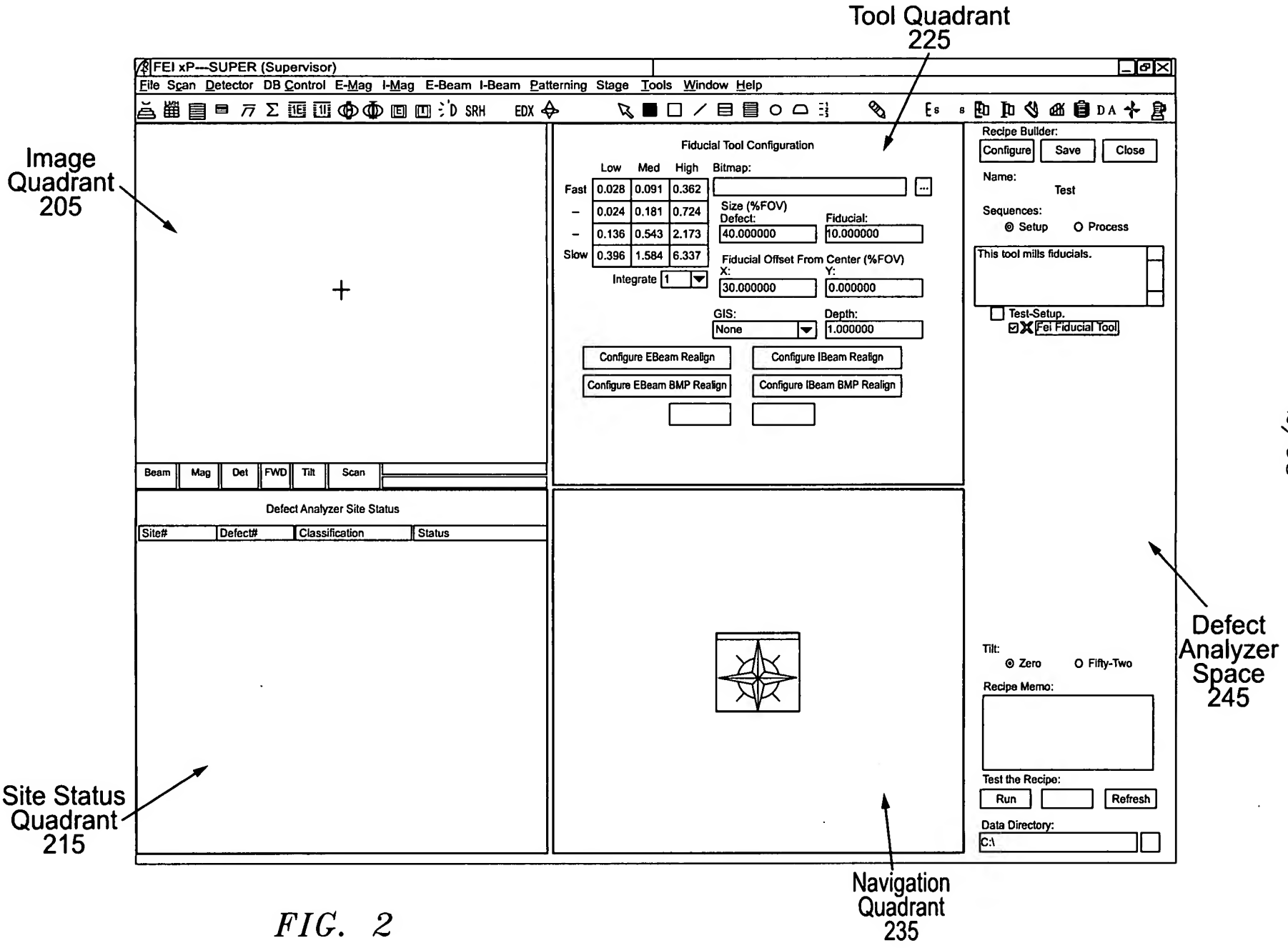

Tool Quadrant
225
Image
Quadrant
205
FEI xP---SUPER (Supervisor)
File Scan Detector DB Control E-Mag I-Mag E-Beam I-Beam Patterning Stage Tools Window Help
Fiducial Tool Configuration
Low Med High Bitmap:
Fast 0.028 0.091 0.362
0.024 0.181 0.724
0.136 0.543 2.173
Slow 0.396 1.584 6.337
Integrate 1
Size (%FOV)
Defect: 40.000000
Fiducial: 10.000000
Fiducial Offset From Center (%FOV)
X: 30.000000
Y: 0.000000
GIS: None
Depth: 1.000000
Configure EBeam Realign
Configure IBeam Realign
Configure EBeam BMP Realign
Configure IBeam BMP Realign
Recipe Builder:
Configure Save Close
Name:
Test
Sequences:
Setup Process
This tool mills fiducials.
Test-Setup.
Fei Fiducial Tool
Beam Mag Det FWD Tilt Scan
Defect Analyzer Site Status
Site# Defect# Classification Status
Tilt:
Zero Fifty-Two
Recipe Memo:
Test the Recipe:
Run Refresh
Data Directory:
C:\
Defect
Analyzer
Space
245
Site Status
Quadrant
215
Navigation
Quadrant
235

FIG. 2

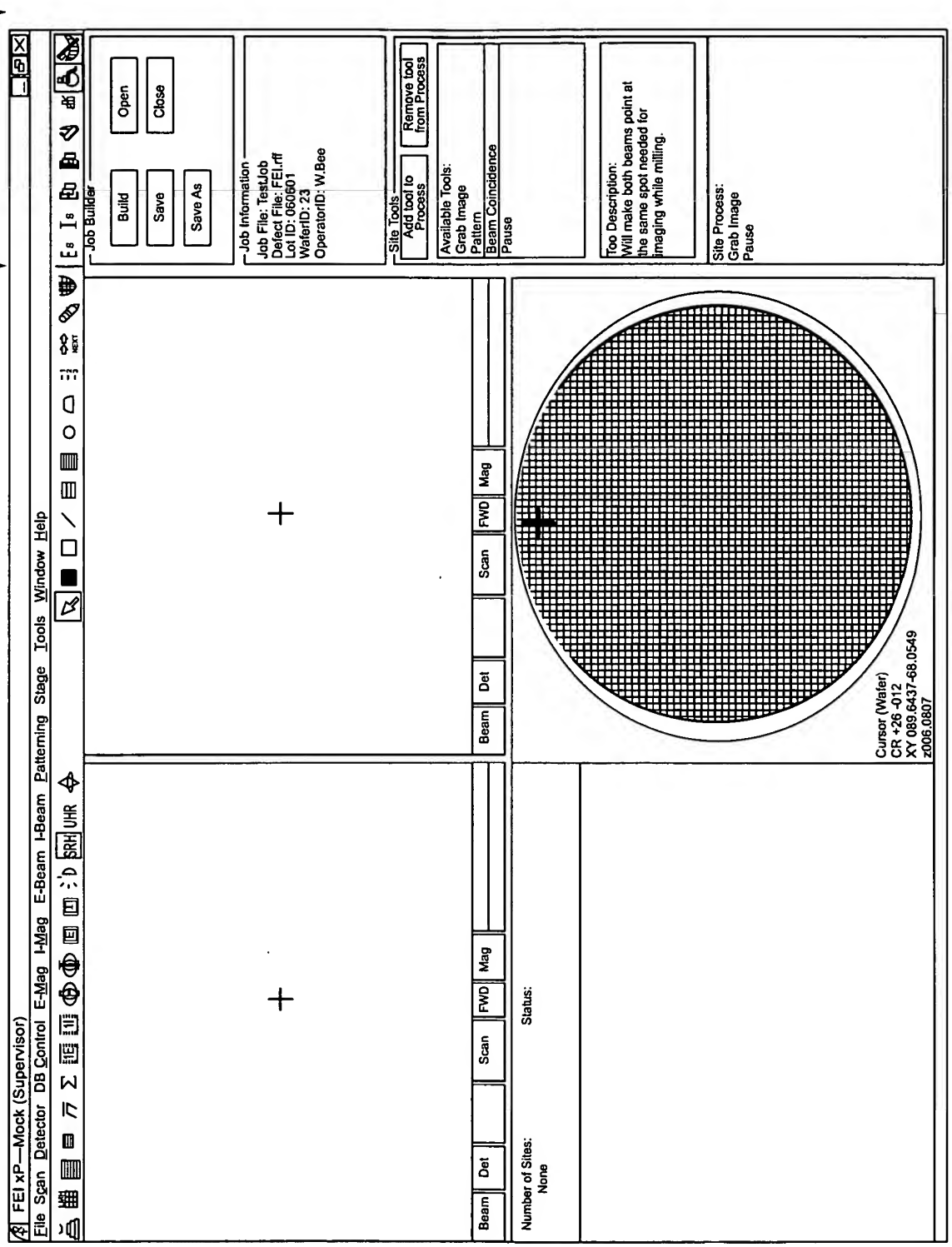

302
FEI xP—Mock (Supervisor)
File Scan Detector DB Control E-Mag I-Mag E-Beam I-Beam Patterning Stage Tools Window Help
Job Builder
Build
Save
Save As
Open
Close
Job Information
Job File: TestJob
Defect File: FEI.rff
Lot ID: 060601
WaferID: 23
OperatorID: W.Bee
Site Tools
Add tool to Process
Remove tool from Process
Available Tools:
Grab Image
Pattern
Beam Coincidence
Pause
Too Description:
Will make both beams point at the same spot needed for imaging while milling.
Site Process:
Grab Image
Pause
Beam
Det
Scan
FWD
Mag
Number of Sites:
None
Status:
Cursor (Wafer)
CR +26 -012
XY 089.6437-68.0549
z006.0807

FIG. 3A

Item	Description
Job Builder:	
Build	Initiates building of new job
Save	Save the job information.
Save As	Functions conventionally
Open	Functions conventionally
Close	Functions conventionally
Job Information	Functions conventionally
Site Tools:	
Add Tool to Process	Inserts selected tool into process
Remove Tool from Process	removes selected tool from process
Available Tools	Displays tools available for processes
Tool Description	Brief description of tool
Site Process	Displays process (recipe) as it is being constructed by user

FIG. 3B

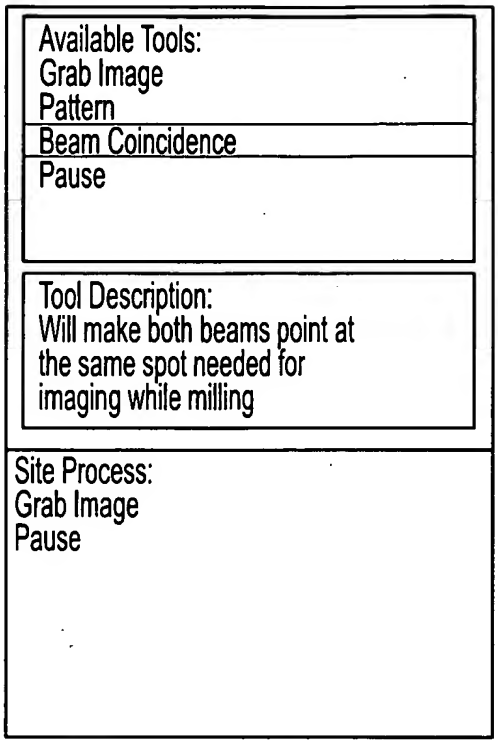

Available Tools:
Grab Image
Pattern
Beam Coincidence
Pause
Tool Description:
Will make both beams point at the same spot needed for imaging while milling
Site Process:
Grab Image
Pause

FIG. 3C

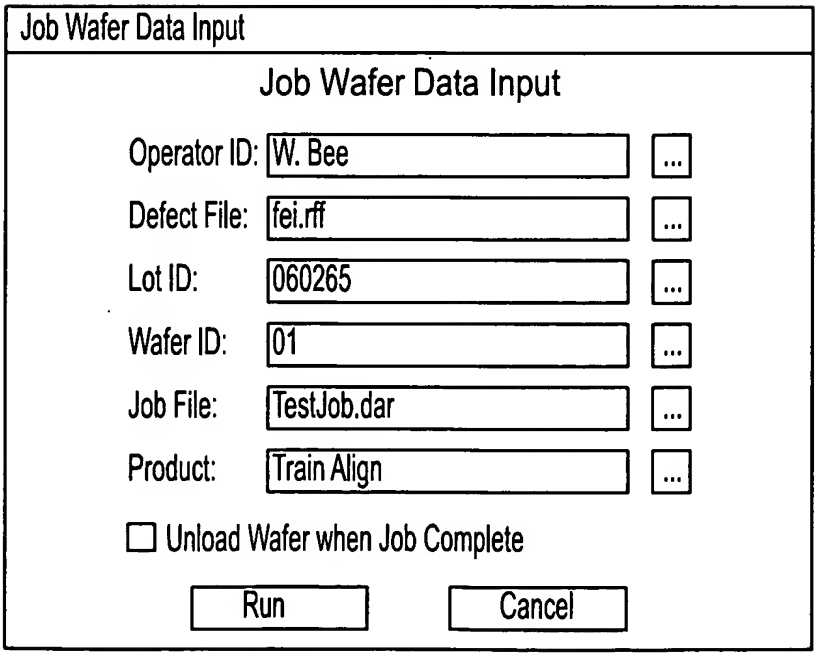

Job Wafer Data Input
Job Wafer Data Input
Operator ID: W. Bee
Defect File: fei.rff
Lot ID: 060265
Wafer ID: 01
Job File: TestJob.dar
Product: Train Align
Unload Wafer when Job Complete
Run
Cancel

FIG. 3D

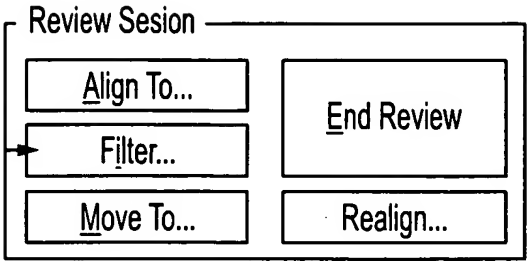

Review Sesion
Align To...
Filter...
Move To...
End Review
Realign...

FIG. 3E

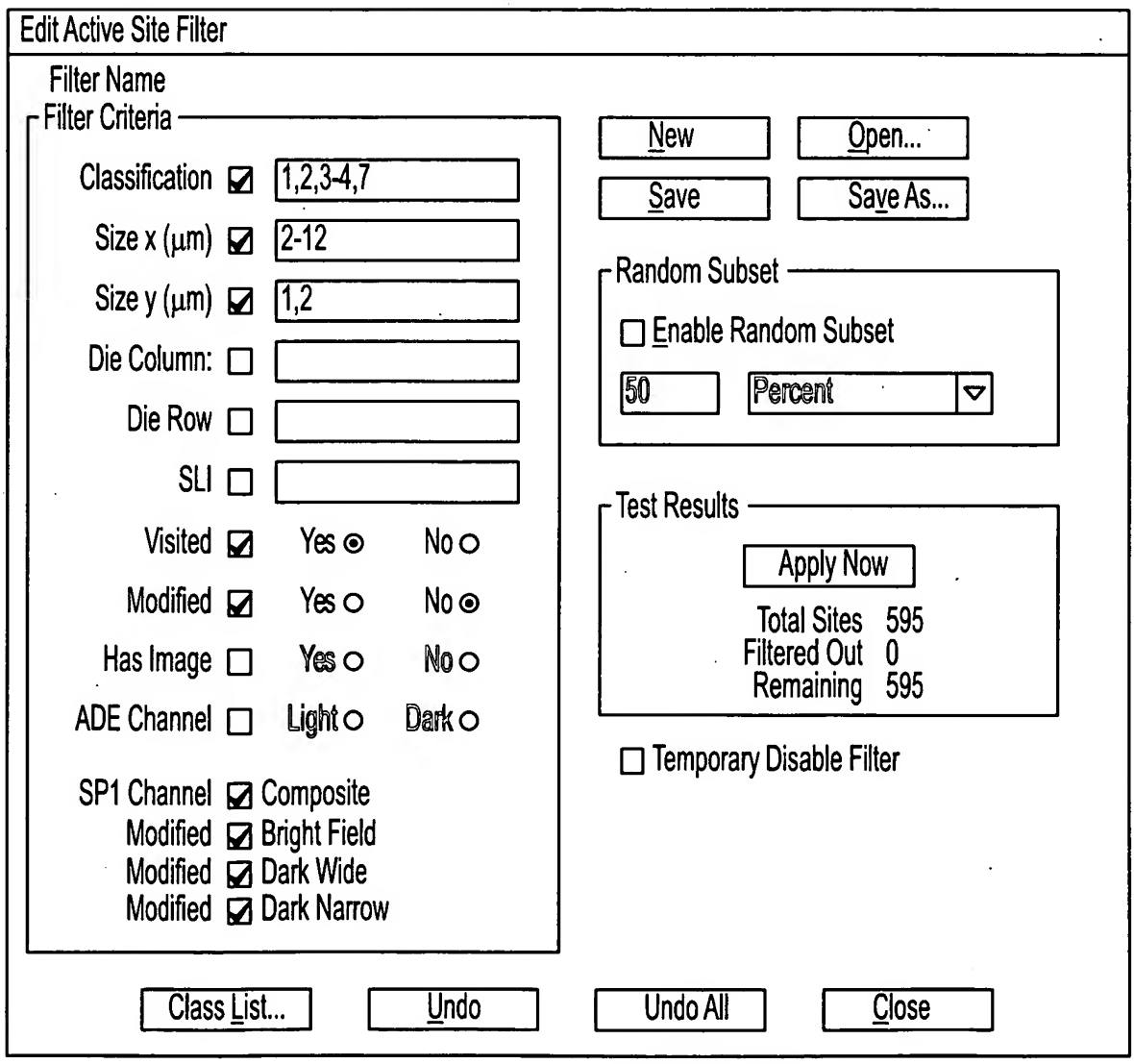

Edit Active Site Filter
Filter Name
Filter Criteria
Classification
1,2,3-4,7
Size x (µm)
2-12
Size y (µm)
1,2
Die Column:
Die Row
SLI
Visited
Yes
No
Modified
Yes
No
Has Image
Yes
No
ADE Channel
Light
Dark
SP1 Channel
Composite
Modified
Bright Field
Modified
Dark Wide
Modified
Dark Narrow
New
Open...
Save
Save As...
Random Subset
Enable Random Subset
50
Percent
Test Results
Apply Now
Total Sites 595
Filtered Out 0
Remaining 595
Temporary Disable Filter
Class List...
Undo
Undo All
Close

FIG. 3F

Interface Items	Description
Filter Name	Identifies the filter.
Filter Criteria	These check boxes and list boxes select the filter criteria
New	Creates a new filter file.
Open	Opens an existing filter.
Save	Saves the edited filter definition. It is available only is allowed by configuration.
Save As	Saves the edited filter definition to a new file name. It is available only if allowed by configuration.
Random Subset	Specifies the maximum number of random sites passing the filter.
Test Results	Tests and reports the effect of site filter changes.
Temporarily Disable Filter	Temporarily disables the active site filter.
Graph	Displays a histogram of the defect sites.
Class List	Opens the Edit Class List dialog box.
Undo	Undoes the last change. You cannot undo changes already saved to file.
Undo All+	Undoes all changes made since dialog box opened. You cannot undo changes already saved to file.
Close	Close the dialog box. Applies the defined filter to the current review session but does not save the filter to file.

FIG. 3G

Criterion	Value Type	Description
Classification	Integer	Classification code assigned to the site
Size X (μm)	Real	X dimension of the site in microns
Size Y (μm)	Real	Y dimension of the site in microns
Die Column+n	Integer	Die column of the die containing the site
Die Row	Integer	Die row of the die containing the site
SLI	Integer	Scattered light intensity reported for the site
Visited	Yes/No	Site has or has not been visited during the review session
Modified	Yes/No	Site has or has not been classified or relocated during the review session
ADE Channel	Light/Dark	Site has or has not been visited during the review session
SP1 Channel	n/a	Site has selected attributes. This filter is active if the defect format is T7x00 and the defect file has more than one channel.
Has Image	Yes/No	Site has or does not have image data associated with it

FIG. 3H

Relational Operators	Meaning
=	Equal to
!=	Not equal to
<	Less than
<=	Less than or equal to
>	Greater than
>=	Greater than or equal to

FIG. 3I

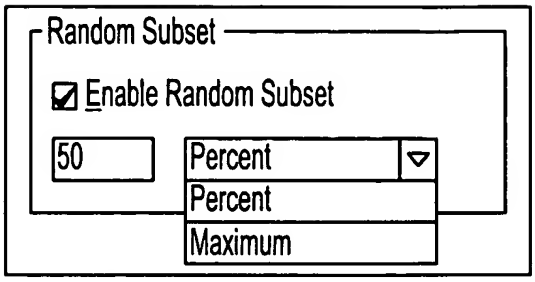


FIG. 3J

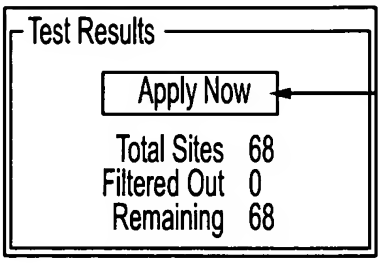


FIG. 3K

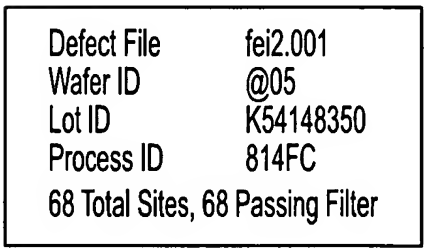


FIG. 3L

FIG. 3M

Defect #	Size X	Size Y	Classification Recipe Name	Die Row

FIG. 3N

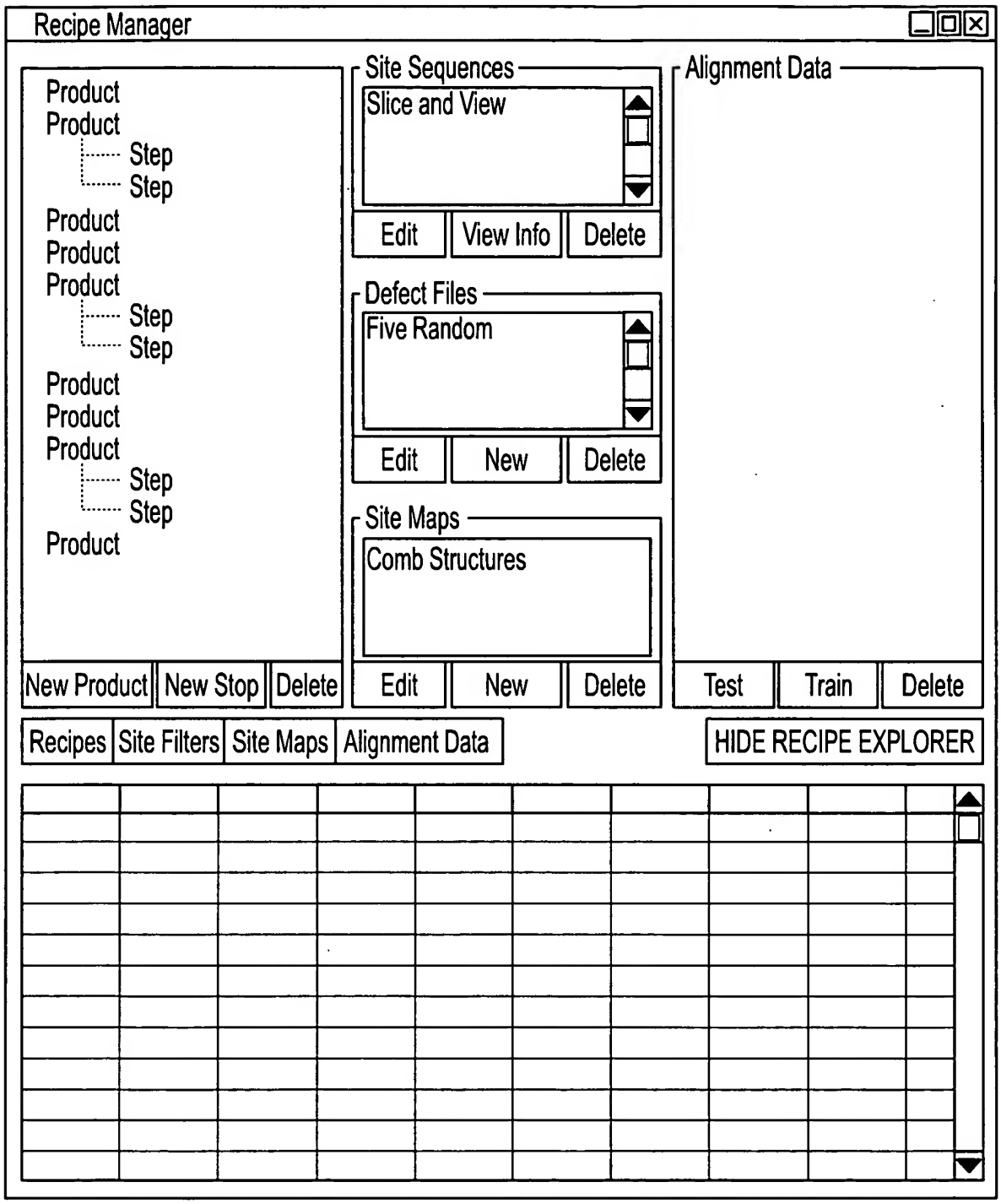

Recipe Manager
Product
Product
Step
Step
Product
Product
Product
Step
Step
Product
Product
Product
Step
Step
Product
New Product
New Stop
Delete
Site Sequences
Slice and View
Edit
View Info
Delete
Defect Files
Five Random
Edit
New
Delete
Site Maps
Comb Structures
Edit
New
Delete
Alignment Data
Test
Train
Delete
Recipes
Site Filters
Site Maps
Alignment Data
HIDE RECIPE EXPLORER

FIG. 30

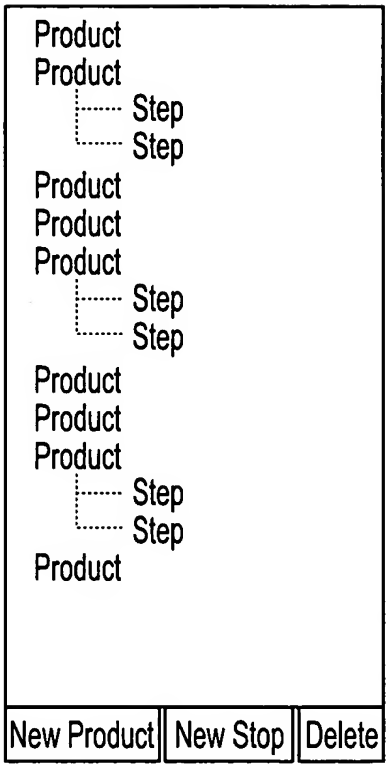

Product
Product
Step
Step
Product
Product
Product
Step
Step
Product
Product
Product
Step
Step
Product
New Product
New Stop
Delete

FIG. 3P

Control	Descriptions	Behavior
Product Product Step Step Product Product Product Step Step Product Product Product Step Step Product	Product/Step Tree: This is the interface through which specific Steps are created, edited, and deleted.	Sorting: Alphabetized by Product, then by Step. Node Behavior: Expandable and Collapsible through a standard interface. Persist Expansions for the life of the dialogue. Scroll Bars: Scrolling should be allowed.
New Product	New Product Button: This is used to add a New Product to the Database.	Click: This should launch a "New Product Wizard" which is described below.
New Stop	New Step Button: This is used to add a New Step to whichever product is selected in the Product/Step Tree View (above).	Enable/Disable: Enable if a Product has been selected. Disabled otherwise. Click: This should launch the "New Step Wizard" which is described below.
Delete	Delete Button: This is used to remove products or steps from the database	Click: This should lauch a standard two-button dialogue with the message. "Permanently Delete [Product/Step] Information?". Then buttons are "Cancel" and "OK".

FIG. 3Q

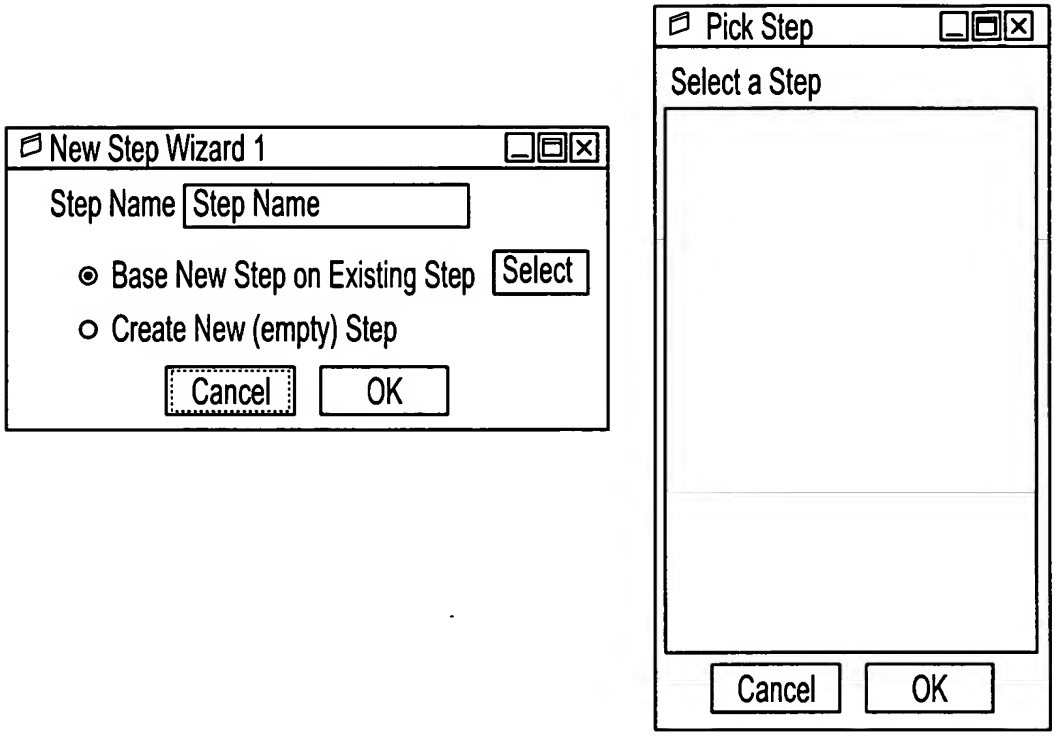

New Step Wizard 1
Step Name
Step Name
Base New Step on Existing Step
Select
Create New (empty) Step
Cancel
OK
Pick Step
Select a Step
Cancel
OK

FIG. 3R

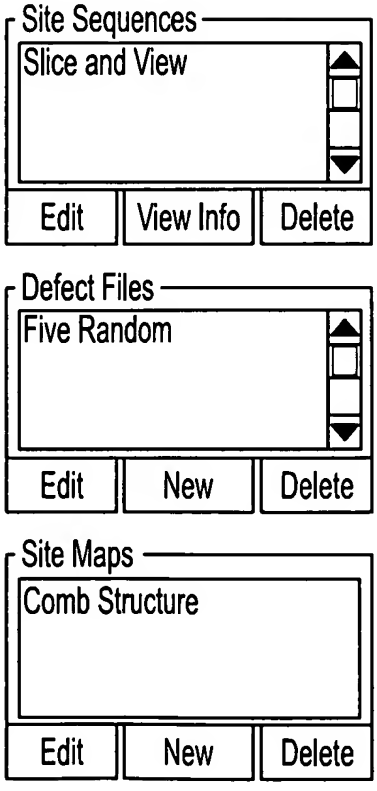

Site Sequences
Slice and View
Edit
View Info
Delete
Defect Files
Five Random
Edit
New
Delete
Site Maps
Comb Structure
Edit
New
Delete

FIG. 3S

Control	Descriptions	Behavior
Slice and View	Site Sequence List Tree View: This displays a list of Site Sequences which can be expanded to show the names of the tools.	Scrolling: Should be scrollable. Node Behavior: Expanded nodes should stay expanded. Alphabetized. Click: This should highlight the site sequence. Default selection: The first site sequence in the list should be highlighted by default. Double-Click: This should expand the node to display the list of tools within the site sequence. Mouse Over: This should display the Site Sequence Name followed by the text description of the site sequence (if any).
Edit	Edit Button: This loads the site sequence into the Recipe Builder page.	(Optionally) the page display should be switched to the Recipe Builder Click: Load the selected site sequence into the recipe builder page
View Info	View Info Button: THIS BUTTON HAS BEEN REMOVED.	NOT APPLICABLE. (the tree view functionality eliminates the previously envisioned function of this button).
Delete	Delete Button: This button removes the site sequence from the database.	Click: This removes the site sequence from the database as far as the user is concerned. The actual implementation should include an "Is Deleted" flag to indicate that the site sequence should not be displayed. This will prevent previously configured process from being invalidated.
Five Random	Site Filter Text Box: This shows a list of all Site Filters available for the selected Product/Step in the Product/Step Tree View control (above).	Alphabetize. Click: Highlight the site filter. Default Selection: The first of the list should be highlighted by default..
Edit	Edit Button: This is used to edit the highlighted site filter.	Click: Launch the site filter dialog for the highlighted site filter.

FIG. 3T

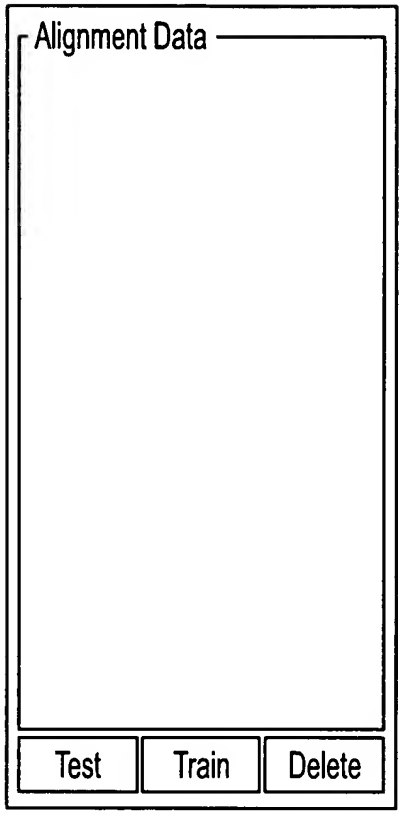

Alignment Data
Test
Train
Delete

FIG. 3U

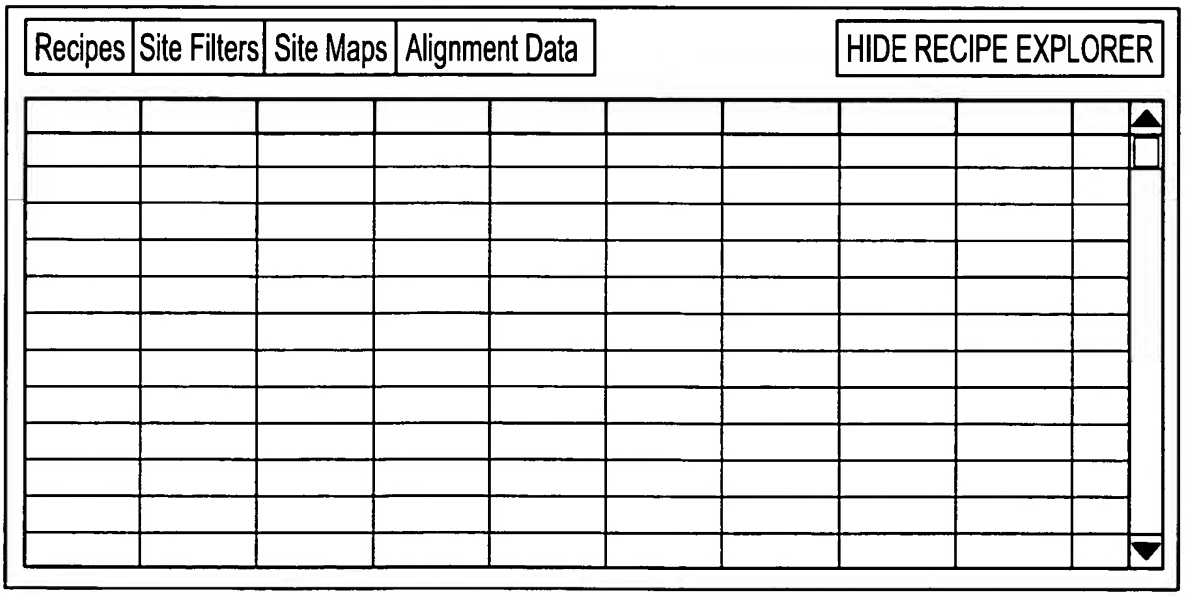

Recipes
Site Filters
Site Maps
Alignment Data
HIDE RECIPE EXPLORER

FIG. 3W

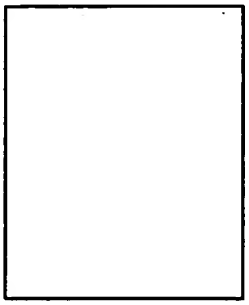
Control	Descriptions	Behavior
	Alignment Data Tree View. This is a tree view showing the Alignment data in the following order.	Node coloring: The nodes should be colored red ir they or a child is untrained. Data Structure: A preliminary data structure for this tree is shown and described in the following section.
Test	Test Button. If appropriate, this should test the selected alignment on the wafer loaded into the system.	Enable/Disable: This is dependent on the highlight node of the Alignment Data Tree View. For certain alignments test functionality will not be appropriate and should not, therefore, be applied. Click: Run the alignment for the highlighted node and all child nodes in the Alignment Data Tree View.
Train	Train Button. If appropriate, this should initiate the portion of the Alignment Training Wizard for the selected node.	Enable/Disable: For some nodes this control may not make sense or may require functionality not provided by the software. In these situations the control should be either disabled or handled through a clear, concise error message. For example, training the zero degree alignments for a wafer loaded at 52 degrees might prompt the user to tilt to zero degrees and try the alignment again. Click: Run the portion(s) of the alignment training wizard for the highlighted node and child nodes. Note that there may be unanticipated exceptions that need to be dealt with (such as no wafer is loaded) that will require increased robustness in handling of errors and exceptions. These will be ferreted out at a later time.
Delete	Delete Button: This permanently deletes alignment data from the database.	Click: This should launch a standard two button dialogue with the message "This will

FIG. 3V

Control	Descriptions	Behavior
HIDE RECIPE EXPLORER		
Recipes	Recipe Tab. This should have the following fields. o Product o Step o Recipe Name o Creation Date	
Site Filters	Site Filter Tab. This should have the fields listed below. As an added feature, there could be a "view filter button" to allow a quick look at the data through a new window o Product o Step o Recipe Name o Creation Date	
Site Maps	Site Map Tab. This should have the fields listed below. As an added feature, there could be a "view filter button" to allow a quick look at the data in a new window (similar to above). o Product o Step o Recipe Name o Creation Date	
Alignment Data	Site Map Tab. This is a complex control, but the should have the fields listed below. Alignment Node should be path which indicates where the alignment data exists on a tree structure identical to that described above. o Product	

FIG. 3X

- ◇ Alignment Name #1
  - ○ Wafer Alignment
    - Product Offset
    - Zero Degrees
      - Alignment Dies
      - Top-Down Electron Beam Image
      - Ion Beam Image
    - Fifty-Two Degrees
      - Alignment Dies
      - Ion Beam Image
      - Electron Beam Image
  - ○ System Calibrations
    - Height Probe Offset
      - Zero Degrees
      - Fifty-Two Degrees
- ◇ Alignment Name #2

FIG. 3Y

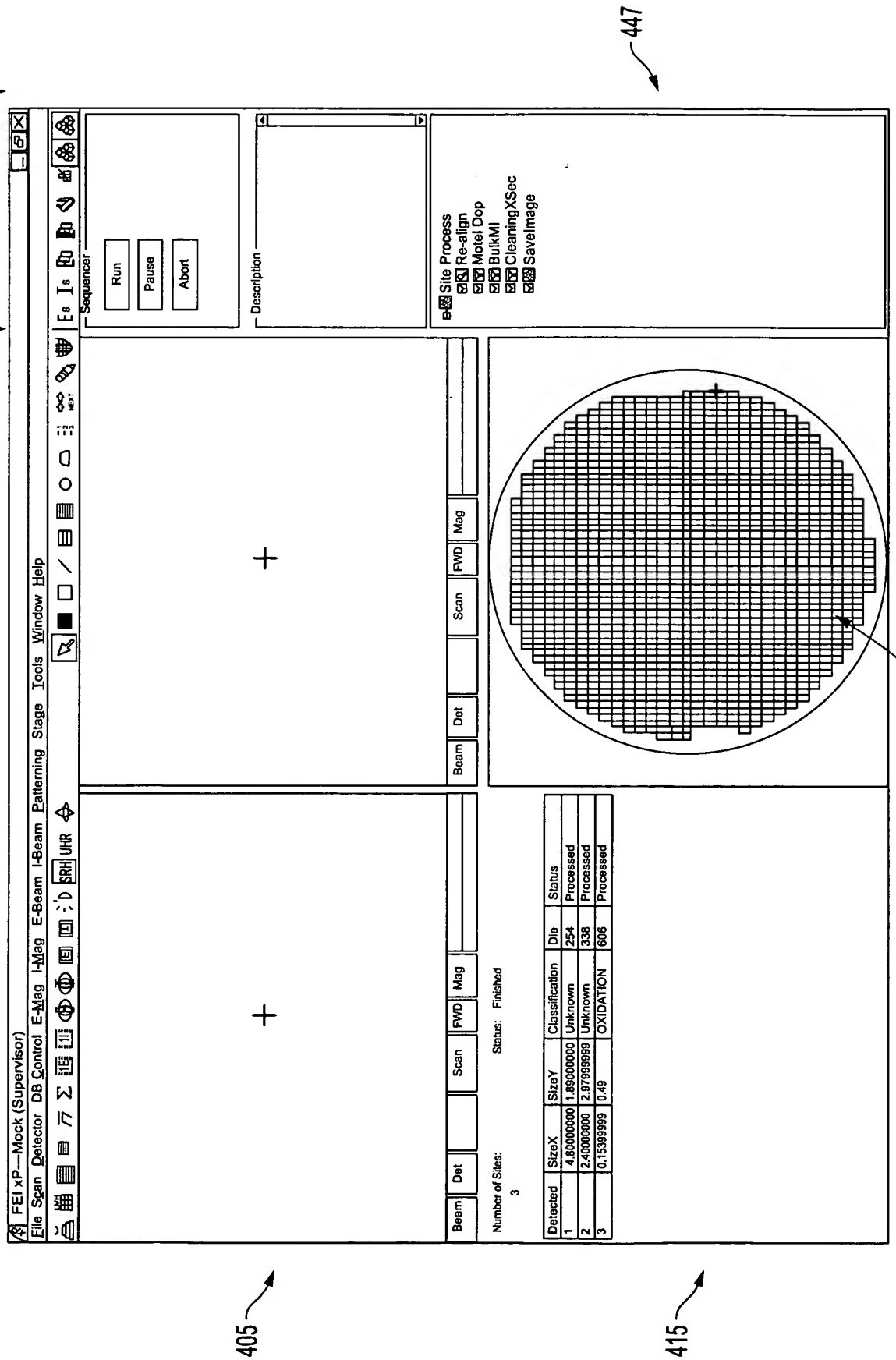

445
447
425
427
405
415
FEI xP—Mock (Supervisor)
File Scan Detector DB Control E-Mag I-Mag E-Beam I-Beam Patterning Stage Tools Window Help
Sequencer
Run
Pause
Abort
Description
Site Process
Re-align
Motel Dop
BulkMI
CleaningXSec
SaveImage
Beam
Det
Scan
FWD
Mag
Number of Sites: 3
Status: Finished
Detected | SizeX | SizeY | Classification | Die | Status
1 | 4.80000000 | 1.89000000 | Unknown | 254 | Processed
2 | 2.40000000 | 2.97899999 | Unknown | 338 | Processed
3 | 0.15399999 | 0.49 | OXIDATION | 606 | Processed

FIG. 4A

Item	Description
Run	Loads the wafer and runs the selected job.
Pause	Pause job execution
Abort	Terminate job execution
Description	Comment text describing job if included in job
Site Process	Displays job process tools

FIG. 4B

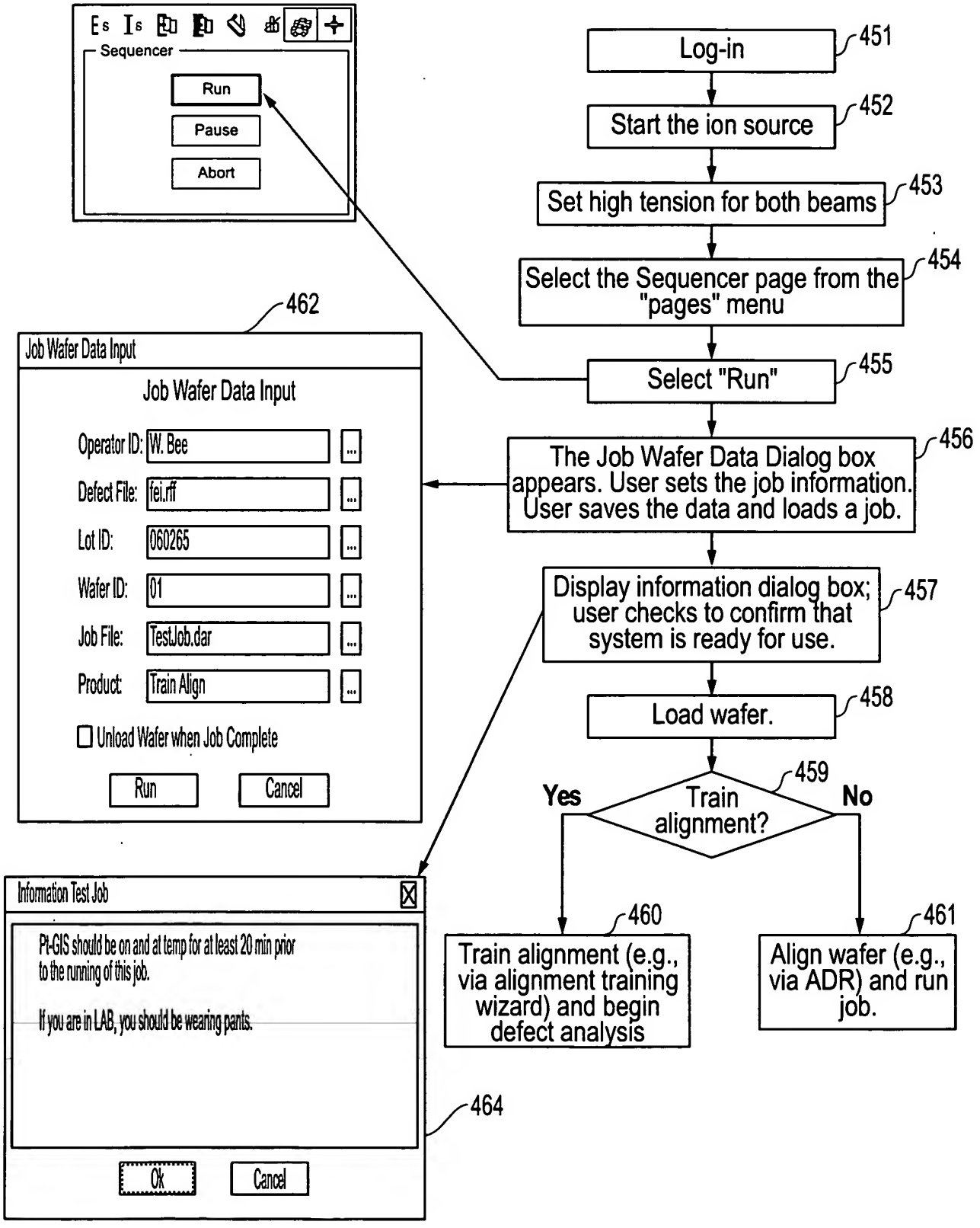

Sequencer
Run
Pause
Abort
Log-in
451
Start the ion source
452
Set high tension for both beams
453
Select the Sequencer page from the "pages" menu
454
Select "Run"
455
The Job Wafer Data Dialog box appears. User sets the job information. User saves the data and loads a job.
456
Display information dialog box; user checks to confirm that system is ready for use.
457
Load wafer.
458
Train alignment?
459
Yes
No
Train alignment (e.g., via alignment training wizard) and begin defect analysis
460
Align wafer (e.g., via ADR) and run job.
461
462
Job Wafer Data Input
Job Wafer Data Input
Operator ID: W. Bee
Defect File: fei.rff
Lot ID: 060265
Wafer ID: 01
Job File: TestJob.dar
Product: Train Align
Unload Wafer when Job Complete
Run
Cancel
Information Test Job
Pt-GIS should be on and at temp for at least 20 min prior to the running of this job.
If you are in LAB, you should be wearing pants.
Ok
Cancel
464

FIG. 4C

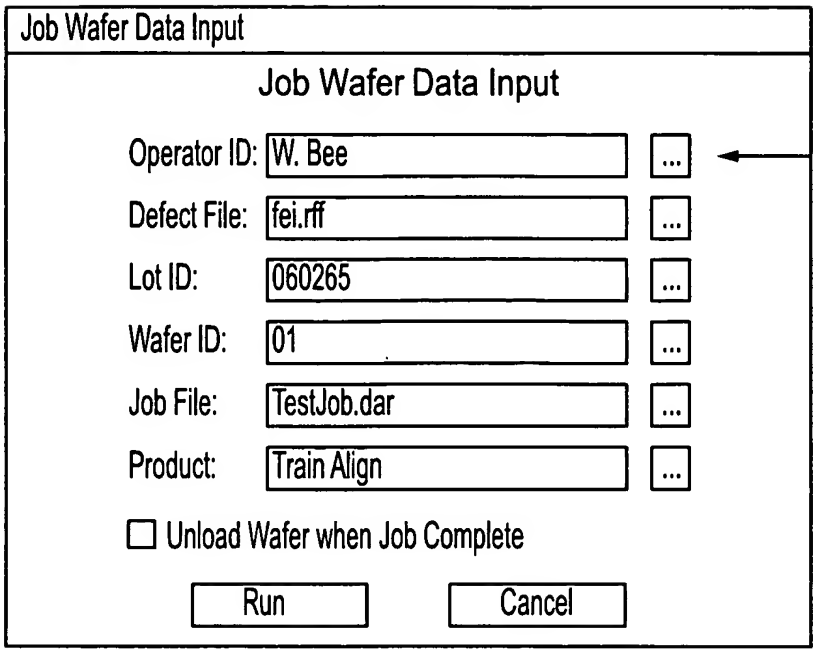

Job Wafer Data Input
Job Wafer Data Input
Operator ID:
W. Bee
Defect File:
fei.rff
Lot ID:
060265
Wafer ID:
01
Job File:
TestJob.dar
Product:
Train Align
Unload Wafer when Job Complete
Run
Cancel

FIG. 4D

Interface Items	Description
Operator ID	Required field where the user enters name.
Detect File	Defect file for the job. User opens an existing defect file. Clicking the select button opens the Select Defect dialog box.
Lot ID	Maximum of 15 characters. Value is read in from defect file or job file, selected from dialog box, or entered by the operator.
Wafer ID	Maximum of 5 characters. Value is read in from defect file or job file, selected from dialog box, or entered by the operator.
Job File	Selects a recipe or job file. The recipe contains no wafer information. the job file contains wafer information. They have different extensions, daj and .dar.
Product	Identifies the alignment wizard for the wafer. If TRAIN ALIGN is selected, when the user clicks RUN, the Alignment Training wizard starts.
Cass A/B	Shows the slots that are occupied.
Inventory	Inventories the cassettes.
FlexiLock	Shows if wafer is in the cassette.
Unload wafer when job complete	Provides automated wafer unloading when a job is complete.
RUN	Dialog box closes and the Information dialog box displays. When user clicks OK in information dialog box the sequencer runs the job. This button is not active until information for at least one wafer is entered.
Cancel	Dialog box closes without saving the values. In job builder, the dialog box closes and the Add Tool interface displays. In sequencer, a warming box displays so that the user does not unintentional lose information. Then, the Sequencer page becomes active again.
Select button	Open dialog where predefined files, wafer, etc., can be selected.

FIG. 4E

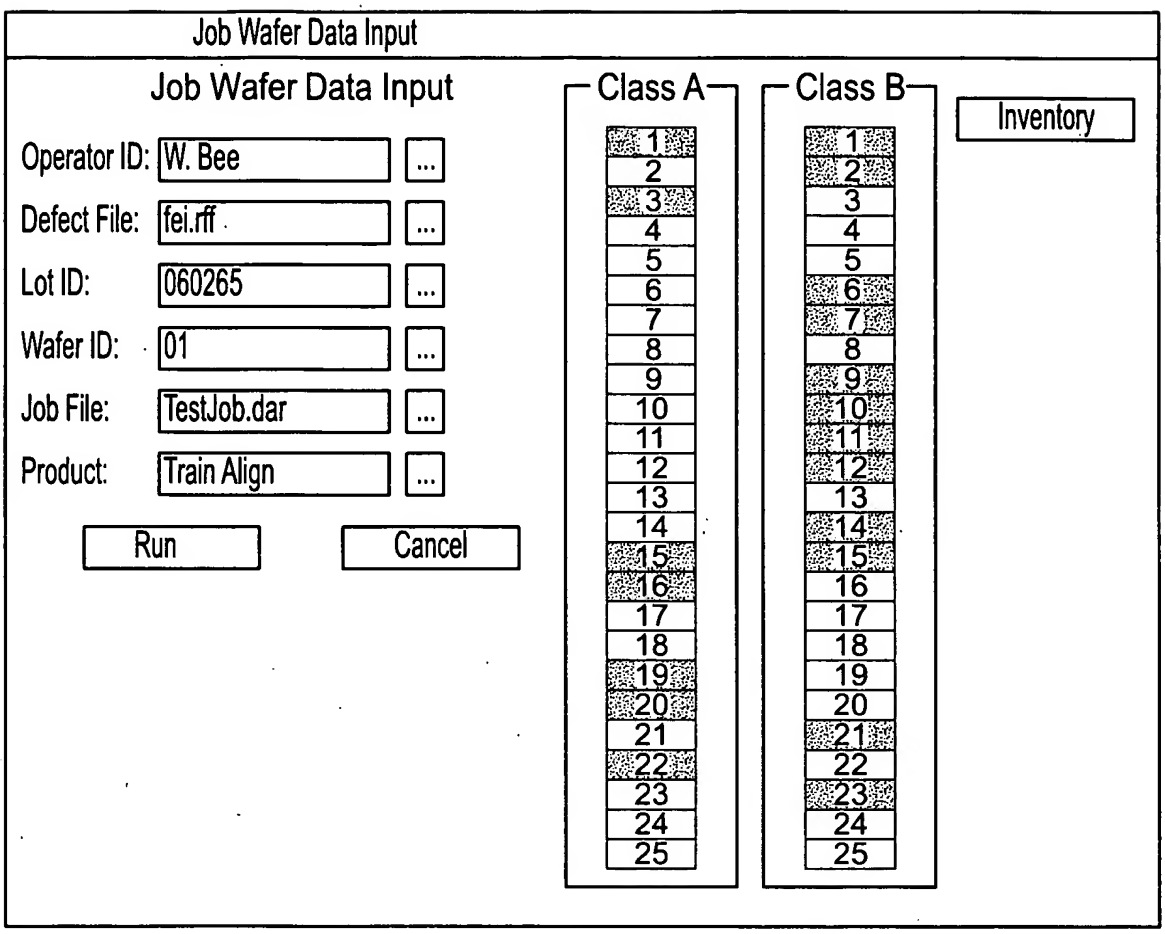

Job Wafer Data Input
Job Wafer Data Input
Operator ID:
W. Bee
Defect File:
fei.rff
Lot ID:
060265
Wafer ID:
01
Job File:
TestJob.dar
Product:
Train Align
Run
Cancel
Class A
Class B
Inventory

FIG. 4F

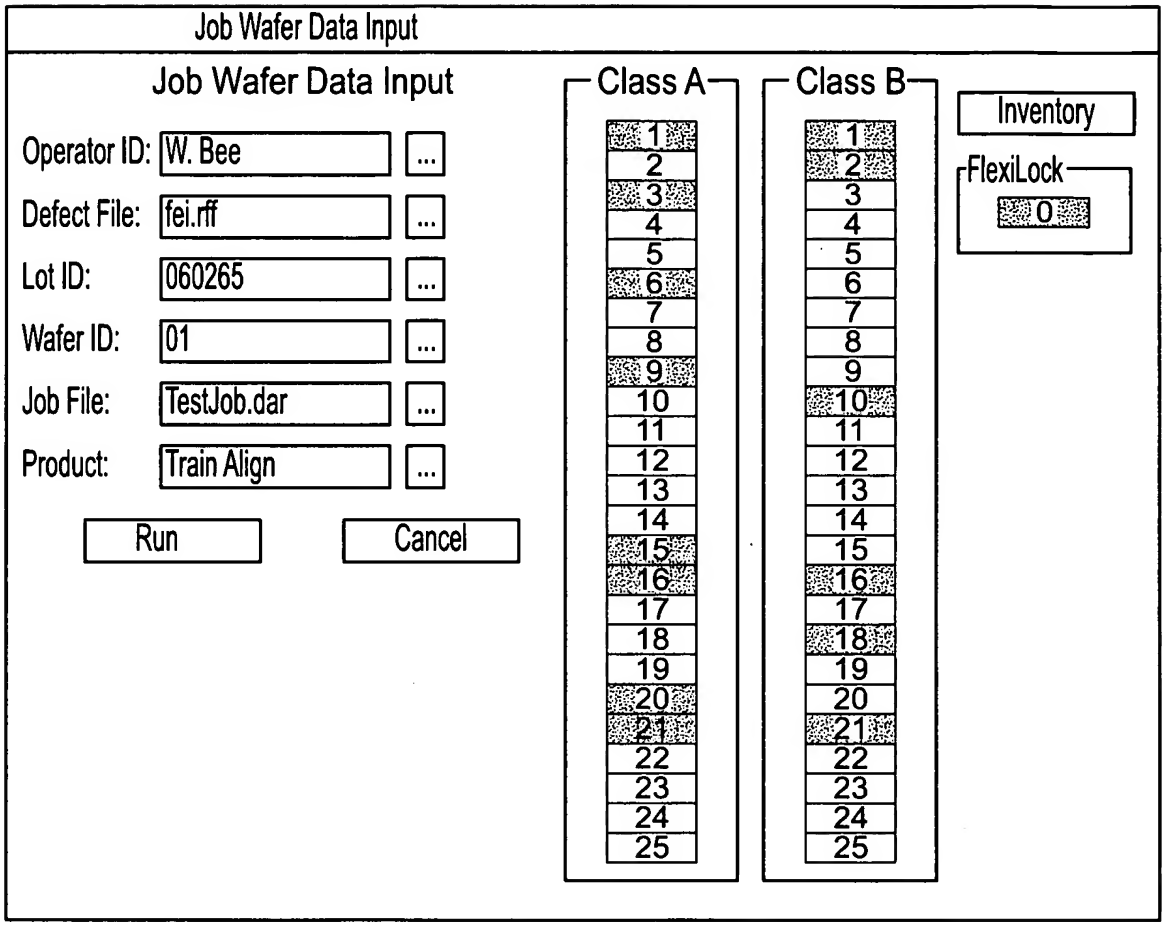

Job Wafer Data Input
Job Wafer Data Input
Operator ID:
W. Bee
Defect File:
fei.rff
Lot ID:
060265
Wafer ID:
01
Job File:
TestJob.dar
Product:
Train Align
Run
Cancel
Class A
Class B
Inventory
FlexiLock
0

FIG. 4G

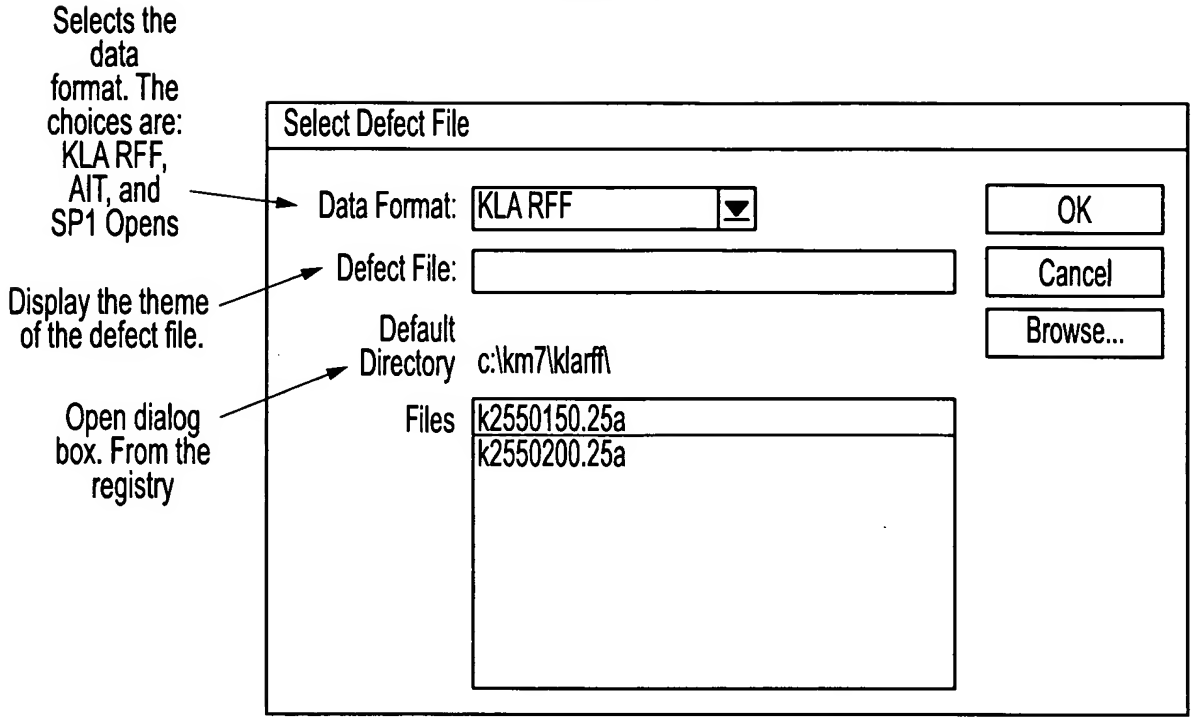

Selects the data format. The choices are: KLA RFF, AIT, and SP1 Opens
Display the theme of the defect file.
Open dialog box. From the registry
Select Defect File
Data Format:
KLA RFF
Defect File:
Default Directory
c:\km7\klarff\
Files
k2550150.25a
k2550200.25a
OK
Cancel
Browse...

FIG. 4H

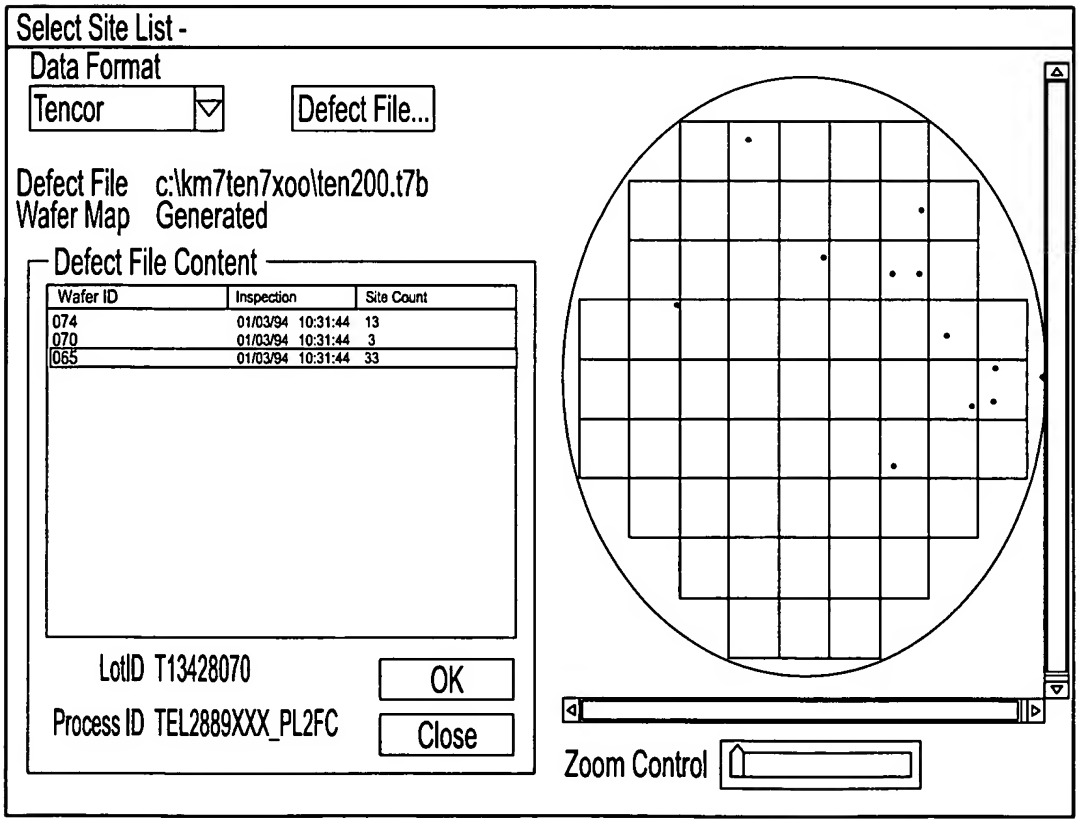

Select Site List -
Data Format
Tencor
Defect File...
Defect File c:\km7ten7xoo\ten200.t7b
Wafer Map Generated
Defect File Content
Wafer ID
Inspection
Site Count
074 01/03/94 10:31:44 13
070 01/03/94 10:31:44 3
065 01/03/94 10:31:44 33
LotID T13428070
Process ID TEL2889XXX_PL2FC
OK
Close
Zoom Control

FIG. 4I

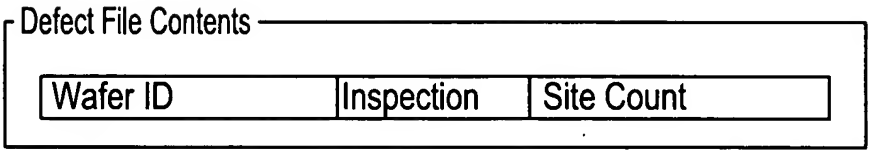


FIG. 4J

Column Header	Description
Wafer ID	The wafer ID as listed in the defect file.
Inspection	The date and time site list was created during inspection.
Wafer ID	The wafer ID as listed in the defect file.

FIG. 4K

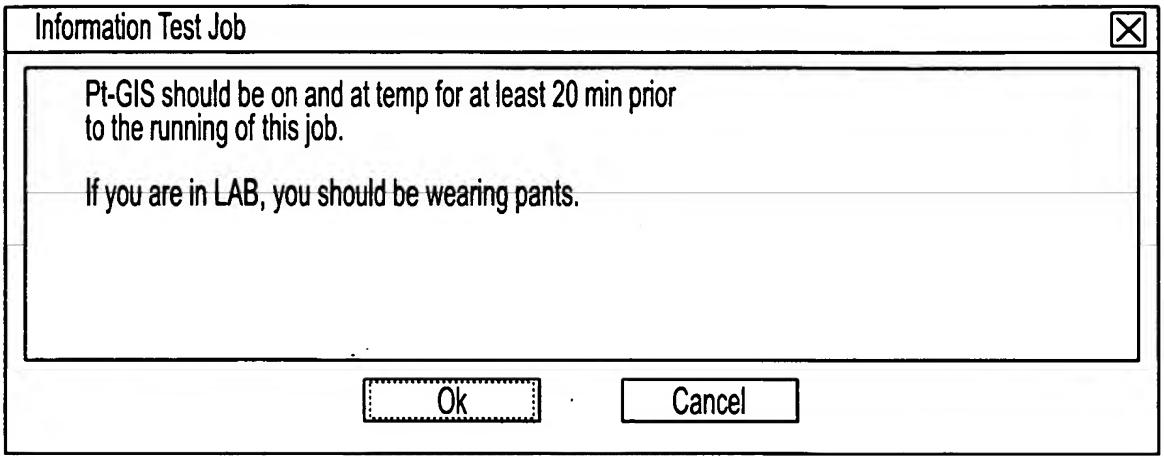


FIG. 4L

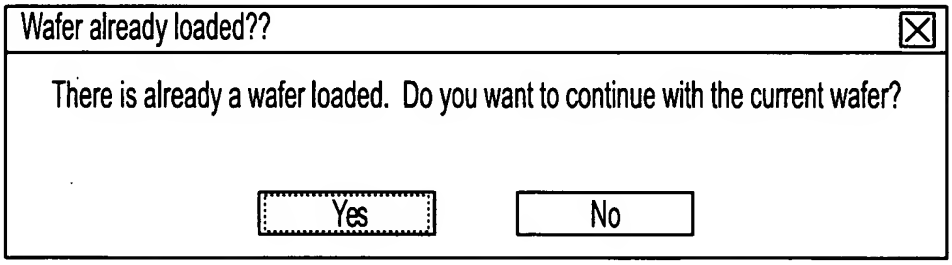


FIG. 4M

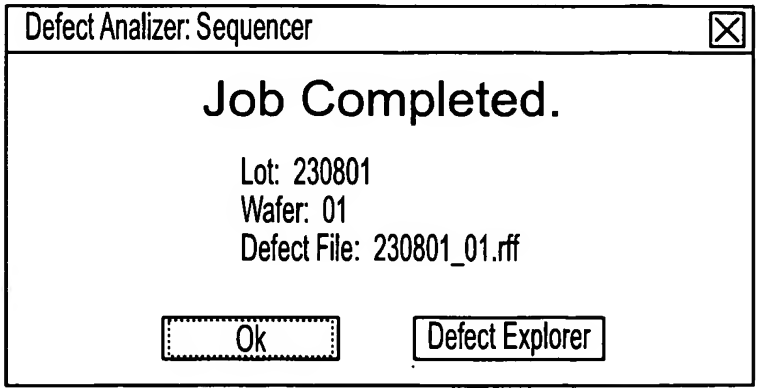


FIG. 4N

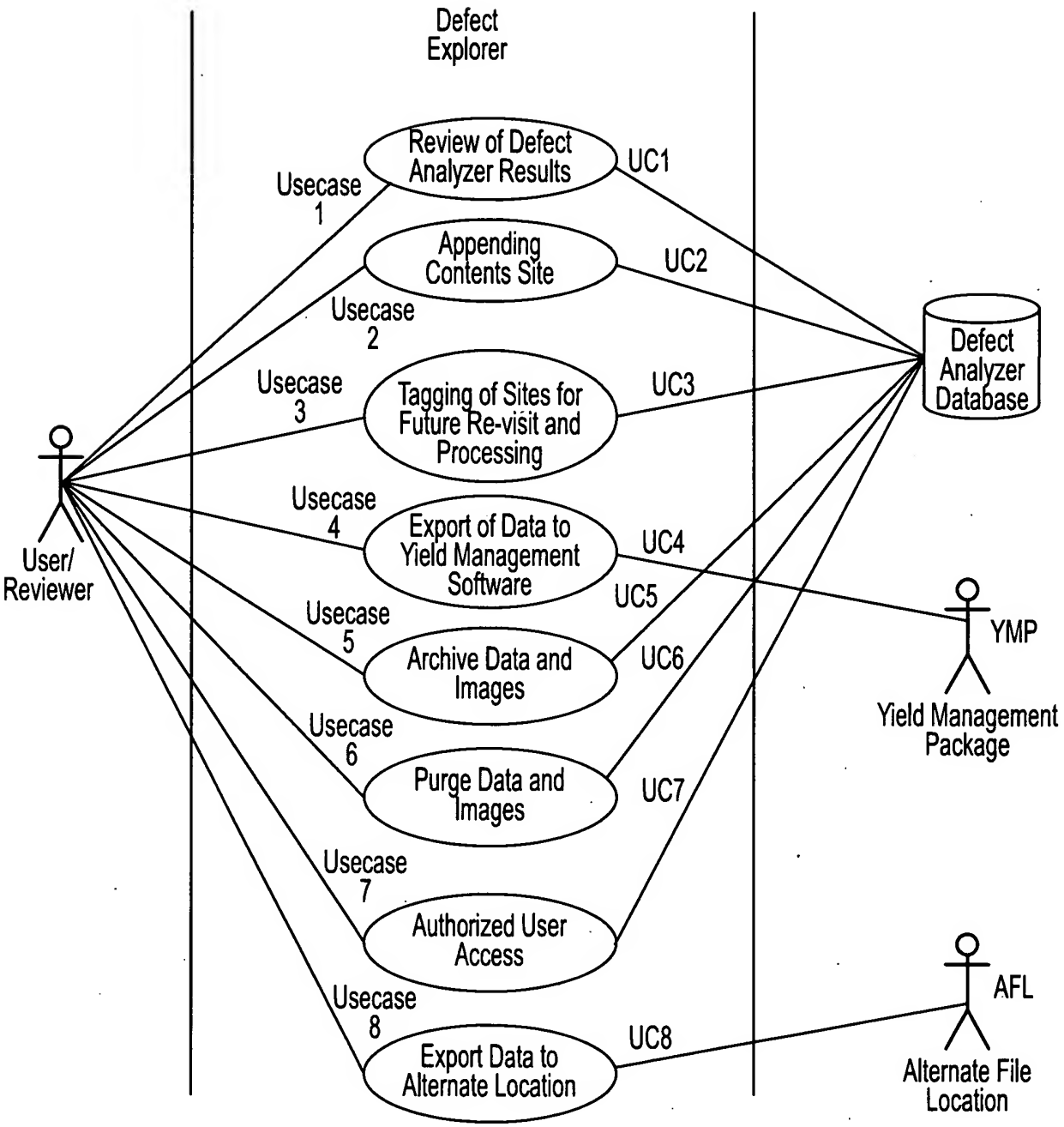

Defect
Explorer
Review of Defect
Analyzer Results
UC1
Usecase
1
Appending
Contents Site
UC2
Usecase
2
Usecase
3
Tagging of Sites for
Future Re-visit and
Processing
UC3
Defect
Analyzer
Database
User/
Reviewer
Usecase
4
Export of Data to
Yield Management
Software
UC4
UC5
Usecase
5
Archive Data and
Images
UC6
YMP
Yield Management
Package
Usecase
6
Purge Data and
Images
UC7
Usecase
7
Authorized User
Access
AFL
Usecase
8
Export Data to
Alternate Location
UC8
Alternate File
Location

FIG. 5

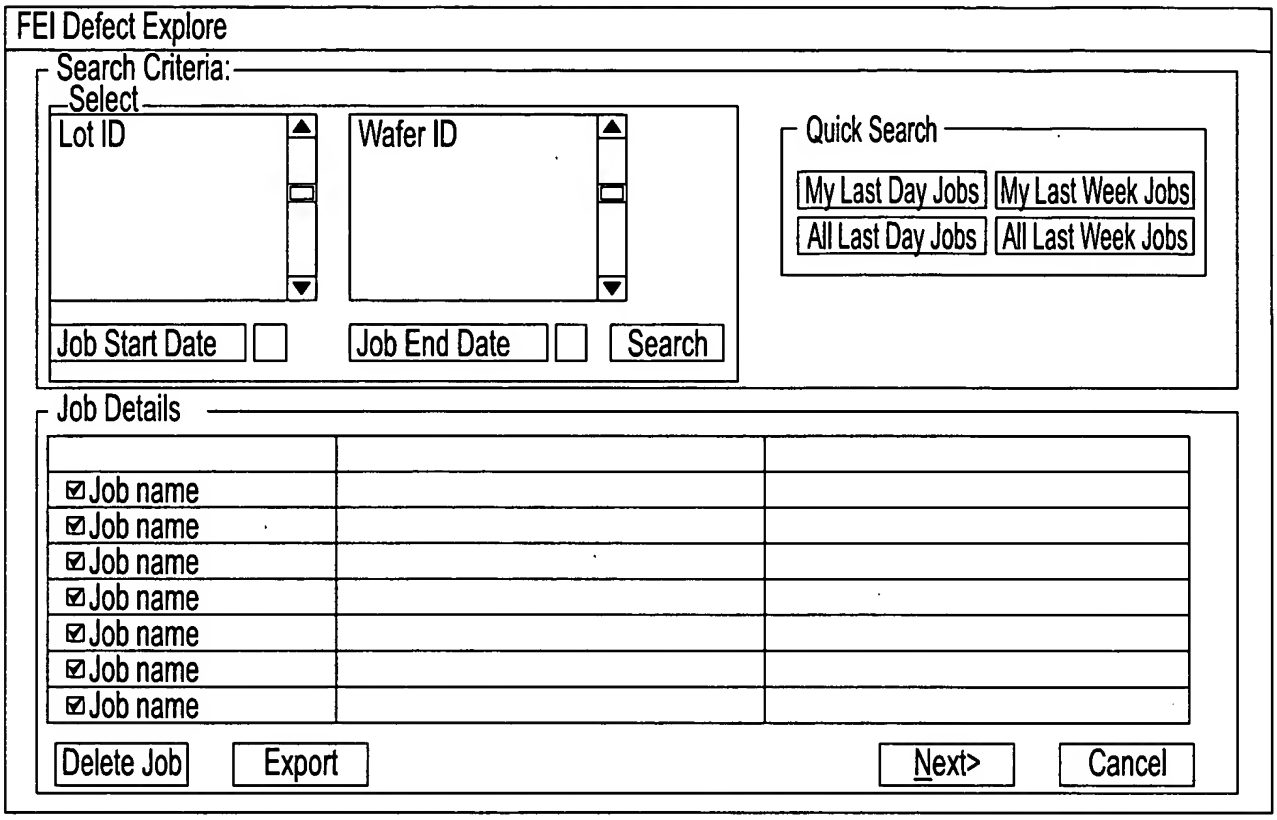

FEI Defect Explore
Search Criteria:
Select
Lot ID
Wafer ID
Quick Search
My Last Day Jobs
My Last Week Jobs
All Last Day Jobs
All Last Week Jobs
Job Start Date
Job End Date
Search
Job Details
Job name
Job name
Job name
Job name
Job name
Job name
Job name
Delete Job
Export
Next>
Cancel

FIG. 6A

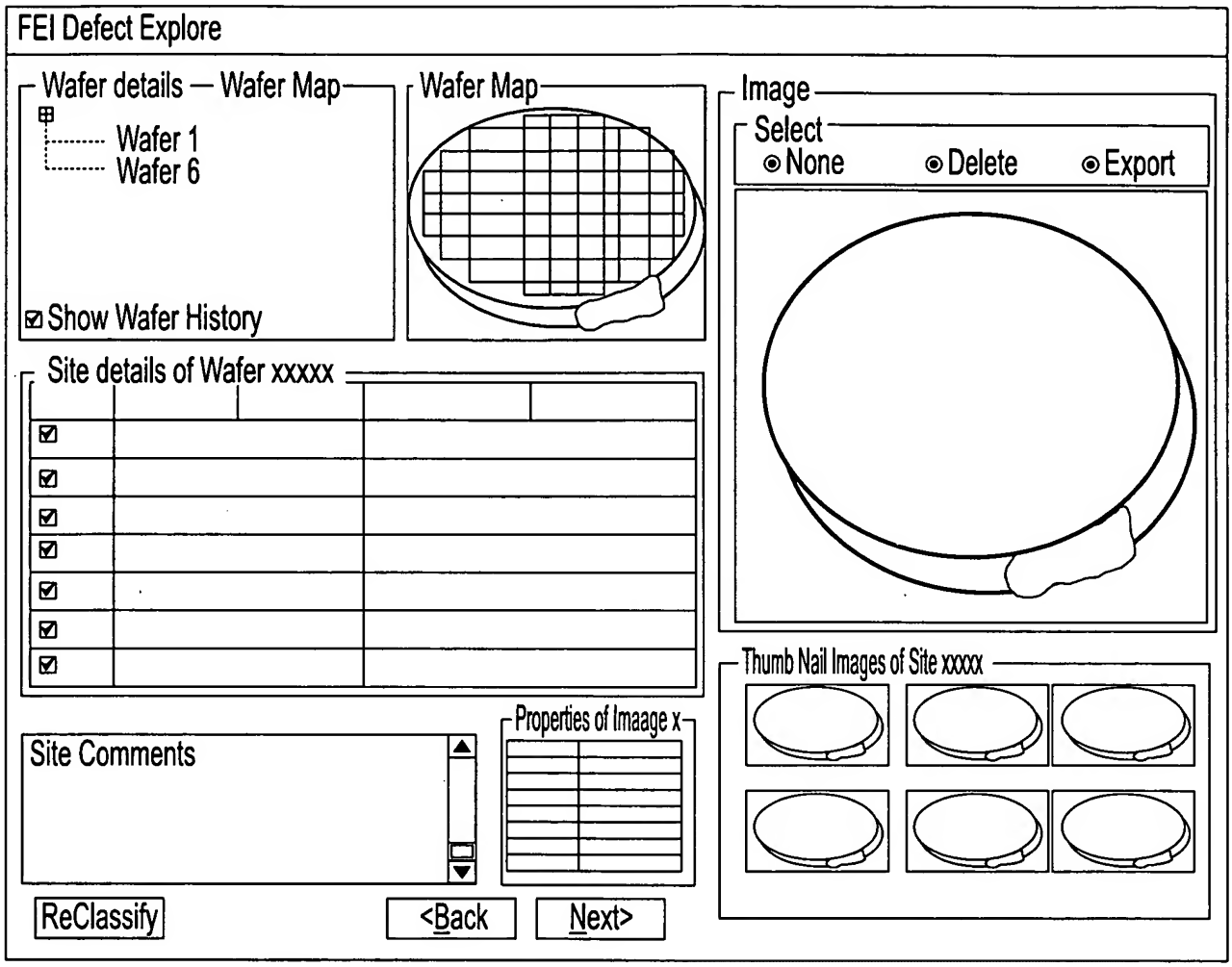

FEI Defect Explore
Wafer details — Wafer Map
Wafer 1
Wafer 6
Show Wafer History
Wafer Map
Image
Select
None
Delete
Export
Site details of Wafer xxxxx
Thumb Nail Images of Site xxxxx
Properties of Imaage x
Site Comments
ReClassify
<Back
Next>

FIG. 6B

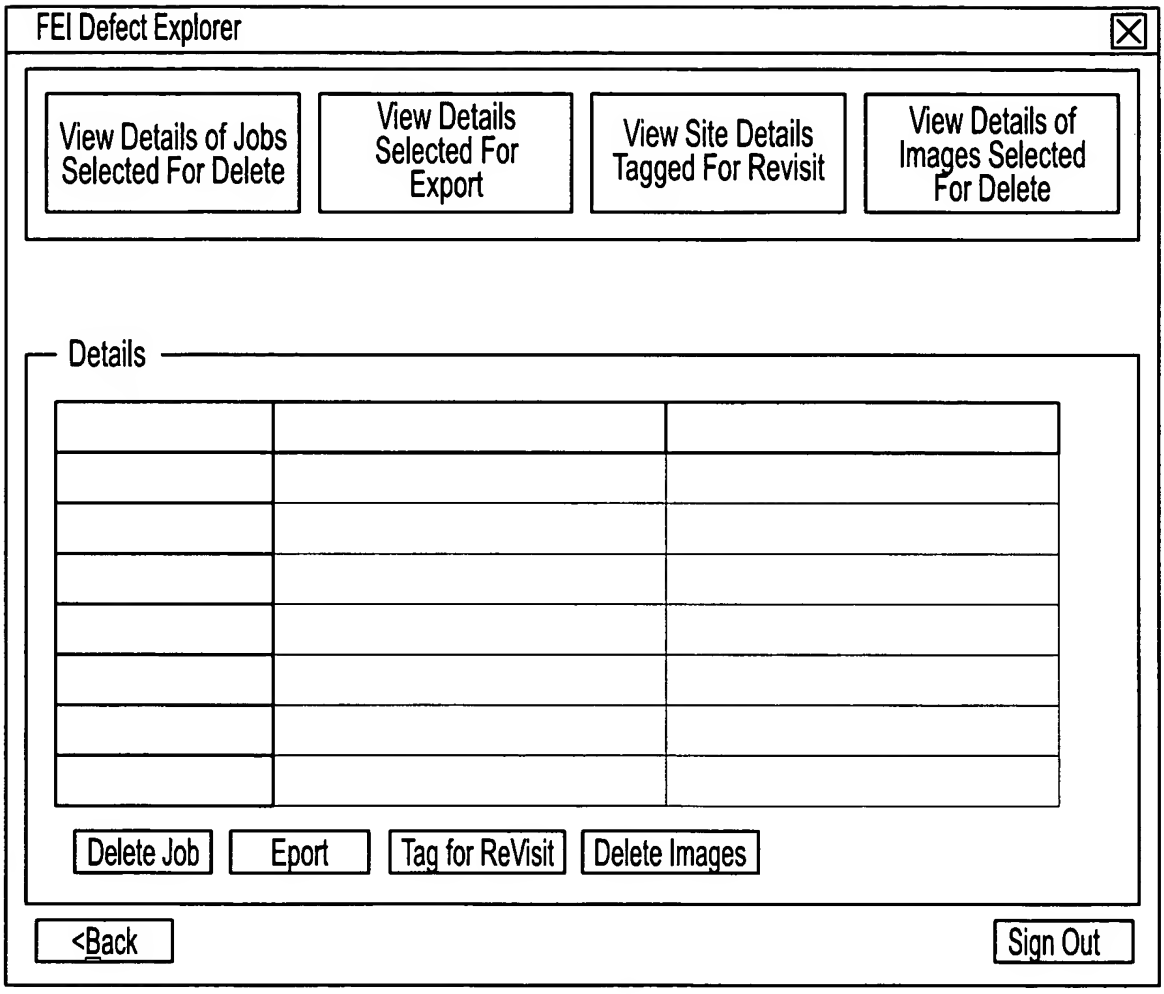

FEI Defect Explorer
View Details of Jobs Selected For Delete
View Details Selected For Export
View Site Details Tagged For Revisit
View Details of Images Selected For Delete
Details
Delete Job
Eport
Tag for ReVisit
Delete Images
<Back
Sign Out

FIG. 6C

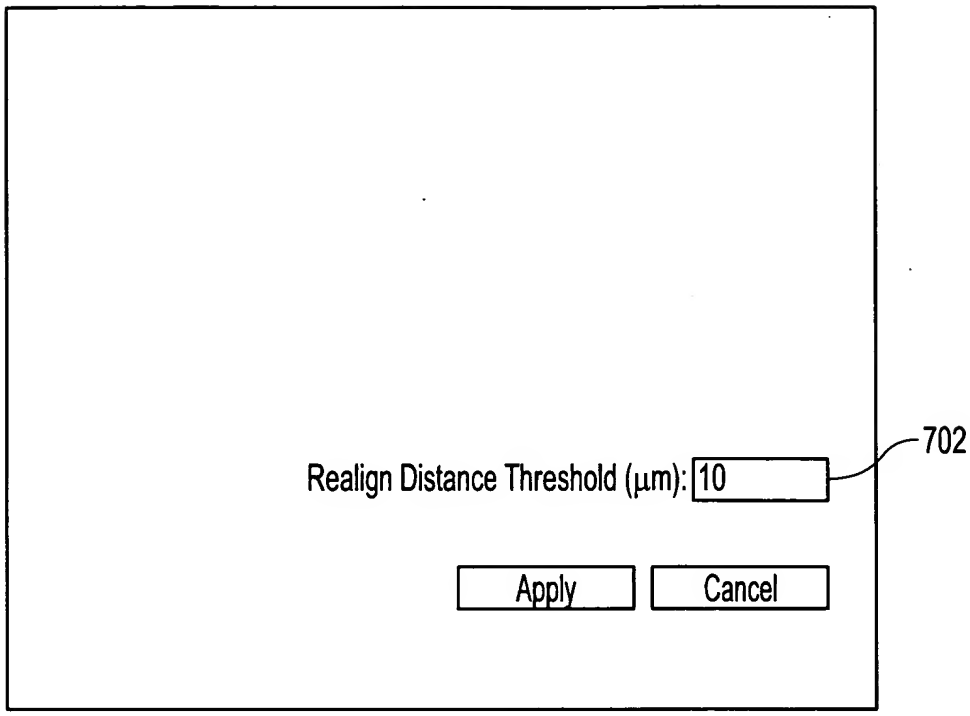


FIG. 6C

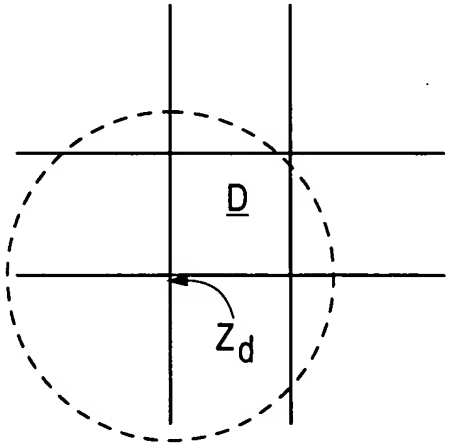


FIG. 7B

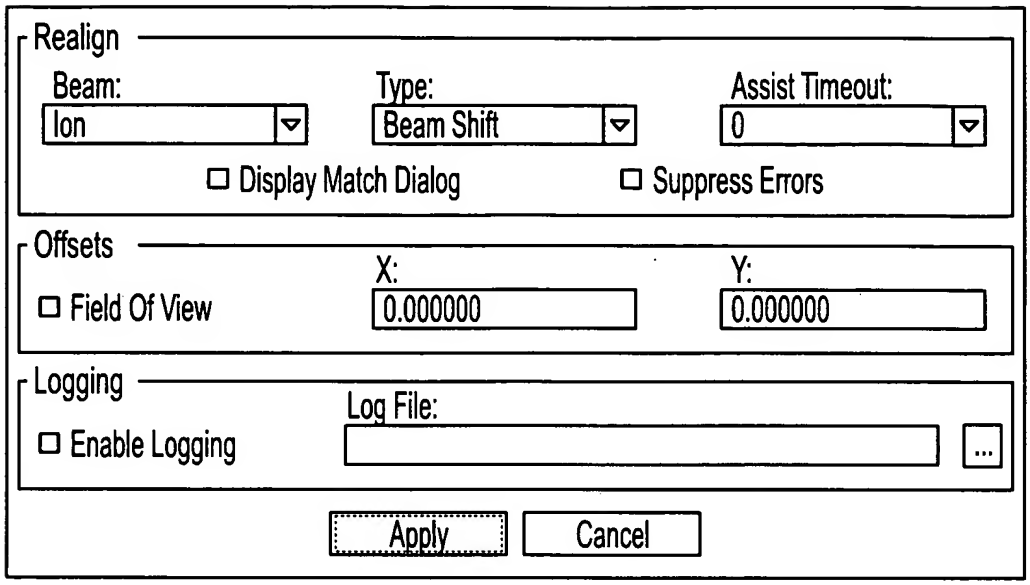

Realign
Beam:
Ion
Type:
Beam Shift
Assist Timeout:
0
Display Match Dialog
Suppress Errors
Offsets
Field Of View
X:
0.000000
Y:
0.000000
Logging
Enable Logging
Log File:
...
Apply
Cancel

FIG. 8A

Item	Description
Realign	
Beam	Specifies the beam to be used in the alignment.
Type	Specifies measurement or the type of alignment. BEAM SHIFT specifies an alignment using beam shift MEASURE instructs the system to measure the X, Y distance between the center of the images and the center of the fiducial mark, in pixels and microns. The result is written to the user-specified log file. STAGE MOVE specifies an alignment using a stage move.
Assist Timeout	Number of seconds a dialog box remains on screen, prompting for user intervention. If this value is 0, no dialog box appears.
Display Match Dialog	Displays the Image Match dialog box (see Image Match).
Suppress Errors	When this option is selected, the system ignores image recognition errors. If ENABLE LOGGING is selected, image recognition errors are written to the user-specified log file.
Offsets:	
Field of View	Specifies a proportional shift of the field of view. When this option is selected, the system shifts the field of view by the proportion of the field of view specified in X and Y. When this option is not selected, the system shifts the field of view by the distance in microns specified in X and Y.
X,Y	Specify the distance by which the system shifts the field of view during alignment. When FIELD OF VIEW is selected, the values specified in X and Y denote a portion of the field of view-e.g., a value of 0.1 equals 10% of the field of view. In one embodiment, acceptable values are 0-1. When FIELD OF VIEW is not selected, the system shifts the field of view by the distance in microns specified in X and Y.
Logging:	
Enable Logging	When this option is selected and a log file is specified, the system logs the following information: Name and path of the image file used for realignment X location of the fiducial in pixels and microns Y location of the fiducial in pixels and microns When MEASURE is selected for TYPE, the X, Y distance between the center of the image and the center of the fiducial mark, in pixels and microns. If the fiducial is not found, the system writes "Fail" to the log file.
Log File	Name and path of the specified log file. Use the adjacent Browse button to navigate to the desired directory.

FIG. 8B

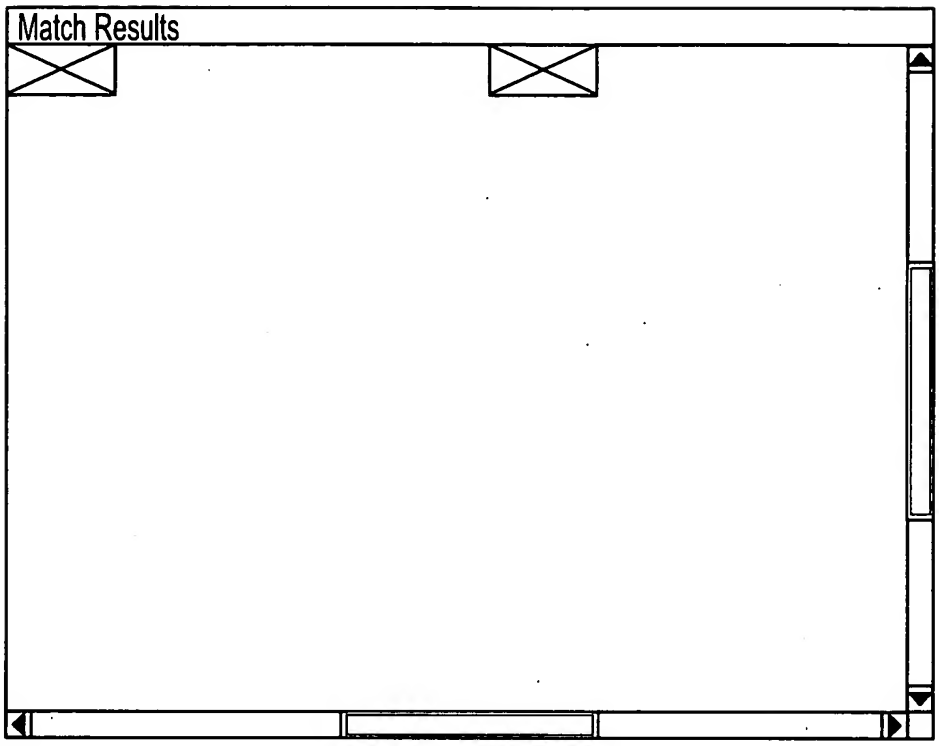

Match Results

FIG. 8C

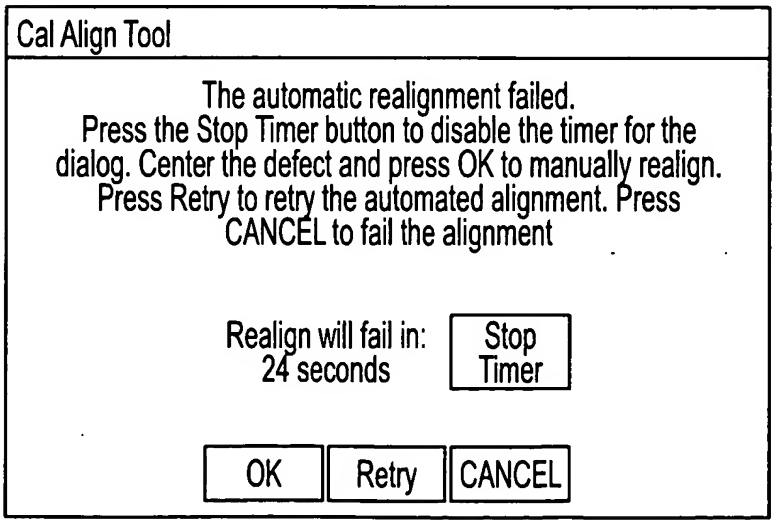

Cal Align Tool
The automatic realignment failed.
Press the Stop Timer button to disable the timer for the dialog. Center the defect and press OK to manually realign. Press Retry to retry the automated alignment. Press CANCEL to fail the alignment
Realign will fail in:
24 seconds
Stop Timer
OK
Retry
CANCEL

FIG. 8D

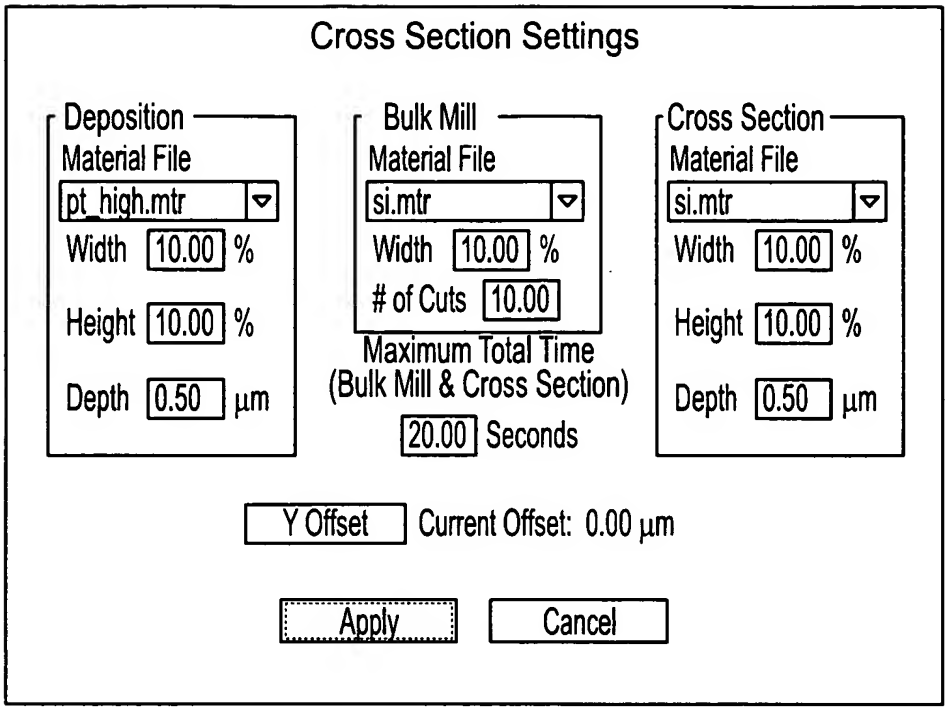

Cross Section Settings
Deposition
Material File
pt_high.mtr
Width 10.00 %
Height 10.00 %
Depth 0.50 µm
Bulk Mill
Material File
si.mtr
Width 10.00 %
# of Cuts 10.00
Maximum Total Time
(Bulk Mill & Cross Section)
20.00 Seconds
Cross Section
Material File
si.mtr
Width 10.00 %
Height 10.00 %
Depth 0.50 µm
Y Offset
Current Offset: 0.00 µm
Apply
Cancel

FIG. 9A

Item	Description
Description	
Material File	Displays a dropdown menu for selecting a material file (.mtr). The list contains an entry for every material file available on the system.
Width	Width of the specified cross section (X), as a percentage of the field of view.
Height	Height of the specified cross section (Y), as a percentage of the field of view. The protective coat will be centered about the location of the cross-section target line.
Depth	Depth of the specified cross section, in microns.
Bulk Mill:	
Number of Cuts	Number of cuts to be made in the bulk mill.
Cross Section:	As in Deposition group, above.
Maximum Total Time	Sets the total pattern time for the bulk mill and cross-section patterning Defect Analyzer uses this value to select the apertures used for bulk milling and cross-sectioning, based on the specified pattern area, depth, and material file.
Y Offset	Displays a horizontal yellow line in the image quadrant, marking the desired upper boundary of the cross section. Click anywhere in the field of view to set the location of this yellow line, then click OK in the accompanying dialog box. For further information, see "Setting Y Offset" on page 4-14.

FIG. 9B

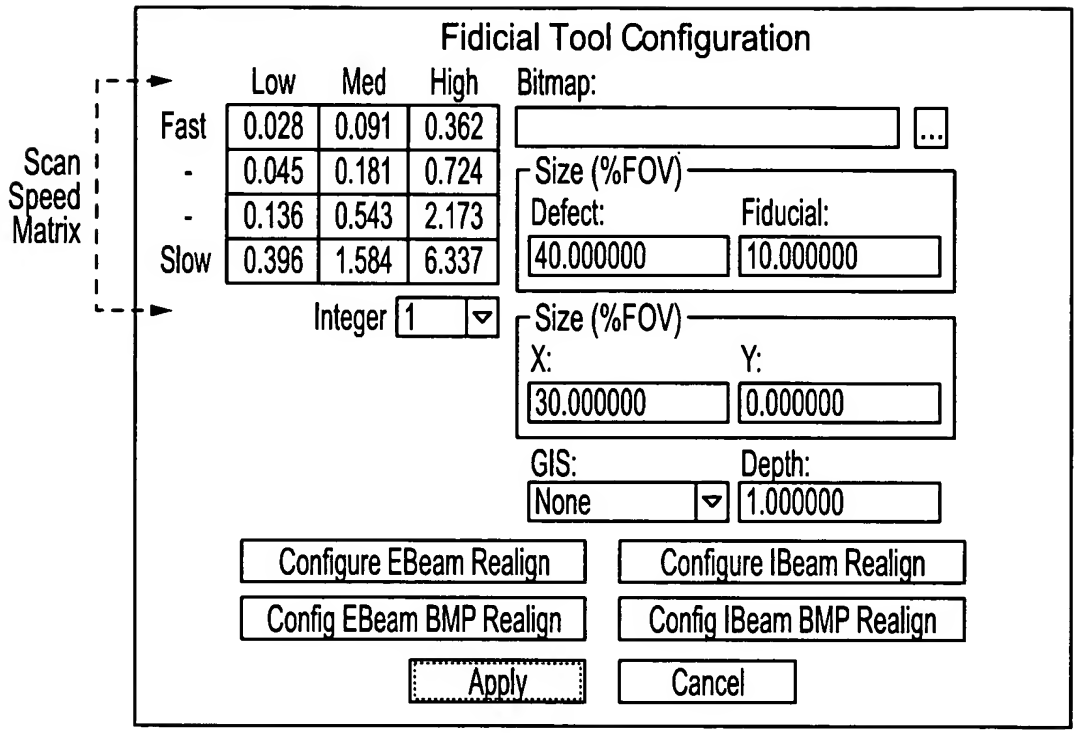

Fidicial Tool Configuration
Scan Speed Matrix
Low
Med
High
Fast
0.028
0.091
0.362
-
0.045
0.181
0.724
-
0.136
0.543
2.173
Slow
0.396
1.584
6.337
Integer
1
Bitmap:
...
Size (%FOV)
Defect:
Fiducial:
40.000000
10.000000
Size (%FOV)
X:
Y:
30.000000
0.000000
GIS:
None
Depth:
1.000000
Configure EBeam Realign
Configure IBeam Realign
Config EBeam BMP Realign
Config IBeam BMP Realign
Apply
Cancel

FIG. 10A

Item	Description
Scan speed matrix	Sets the frame time and resolution used in ion beam and electron beam images collected after milling of the fiducial mark. These images are used for subsequent image recognition.
Integrate	Sets the number of frames to be integrated to allow accumulative noise reduction.
Bitmap	Defect Analyzer converts the specified bitmap to a stream file, based on the grayscale levels of individual pixels in the bitmap. Pixels above the median brightness in the grayscale are omitted from the stream file: pixels below the median brightness are converted to points.
Size (%FOV)	
Defect	Proportion of the field of view to be occupied by the defect.
Fiducial	Size of the fiducial mark, as a percentage of the field of view.
Fiducial Offset From Center (%FOV)	Sets the offset between the center of the image and the center of the fiducial mark, in X and Y, as a percentage of the field of view.
GIS	Selects the GIS to be used in milling the fiducial. The List contains an entry for every beam chemistry available on the system.
Depth	Depth of the fiducial mark, in microns.
Configure EBeam Realign Configure IBeam Realign Configure IBeam BMP Realign, Configure EBeam BMP Realign	CONFIGURE EBEAM BMP REALIGN and CONFIGURE IBEAM BMP REALIGN configure the image recognition software for initial matches between a fiducial mark and the bitmap used as the milling pattern.

FIG. 10B

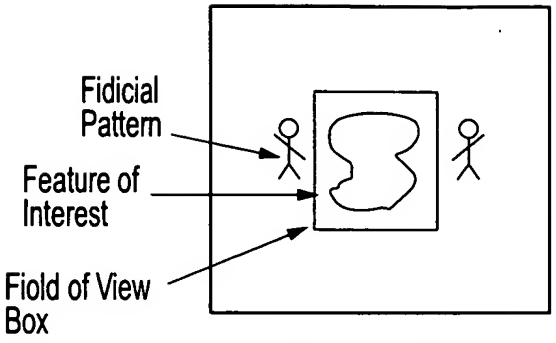


FIG. 10C

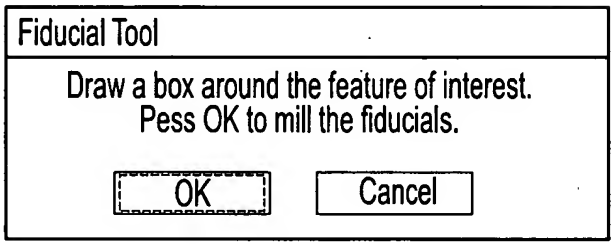


FIG. 10D

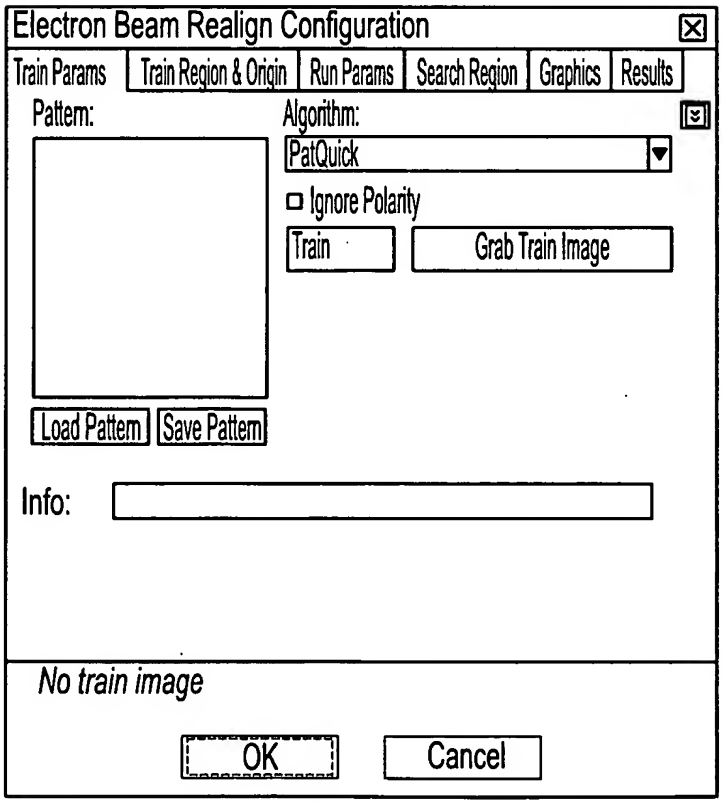


FIG. 10E

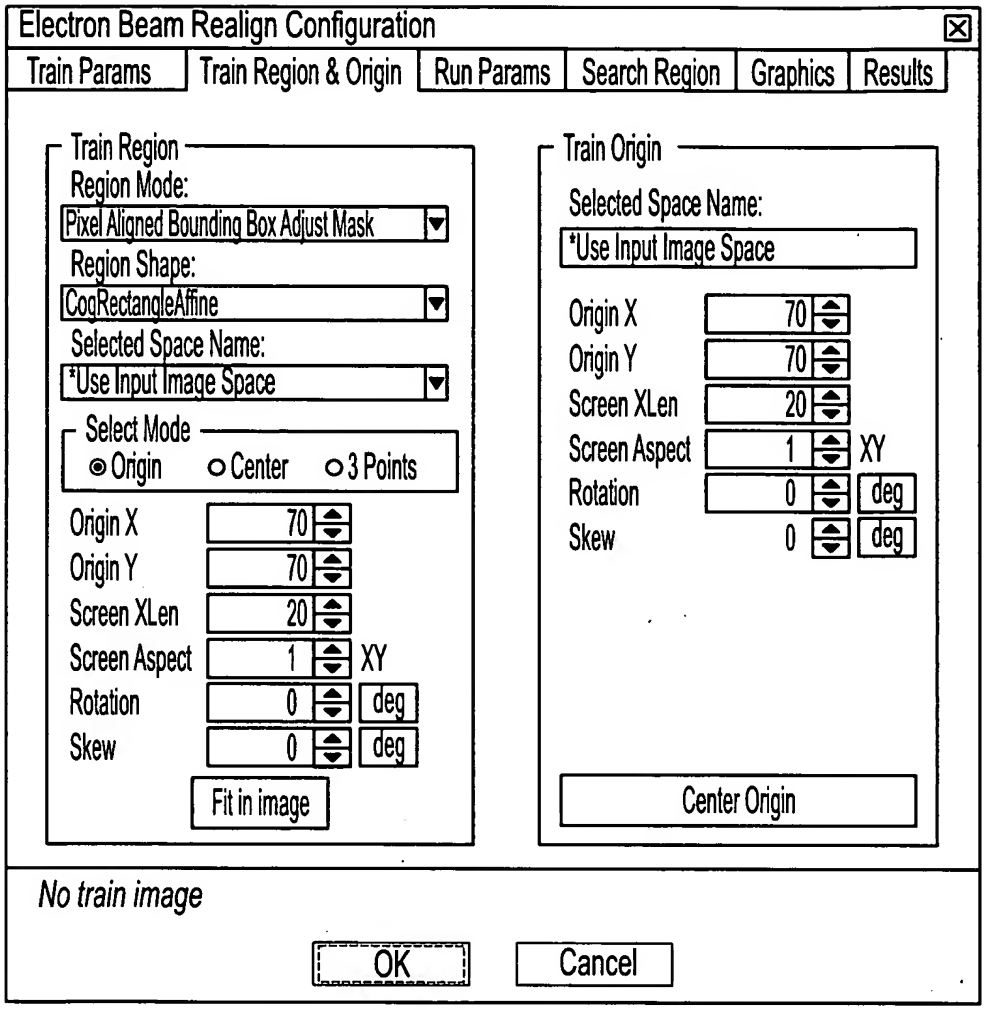

Electron Beam Realign Configuration
Train Params
Train Region & Origin
Run Params
Search Region
Graphics
Results
Train Region
Region Mode:
Pixel Aligned Bounding Box Adjust Mask
Region Shape:
CogRectangleAffine
Selected Space Name:
*Use Input Image Space
Select Mode
Origin
Center
3 Points
Origin X 70
Origin Y 70
Screen XLen 20
Screen Aspect 1 XY
Rotation 0 deg
Skew 0 deg
Fit in image
Train Origin
Selected Space Name:
*Use Input Image Space
Origin X 70
Origin Y 70
Screen XLen 20
Screen Aspect 1 XY
Rotation 0 deg
Skew 0 deg
Center Origin
No train image
OK
Cancel

FIG. 10F

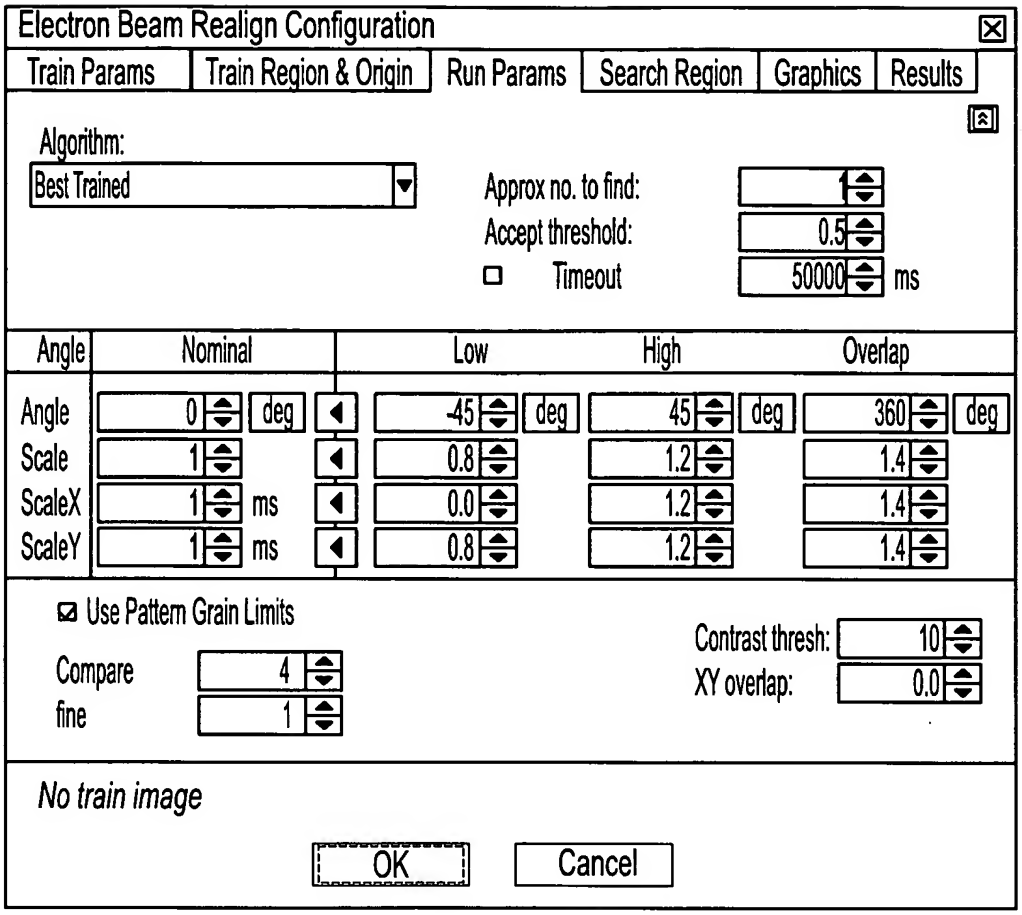

Electron Beam Realign Configuration
Train Params
Train Region & Origin
Run Params
Search Region
Graphics
Results
Algorithm:
Best Trained
Approx no. to find:
Accept threshold:
Timeout
ms
Angle
Nominal
Low
High
Overlap
Angle
Scale
ScaleX
ScaleY
deg
ms
Use Pattern Grain Limits
Compare
fine
Contrast thresh:
XY overlap:
No train image
OK
Cancel

FIG. 10G

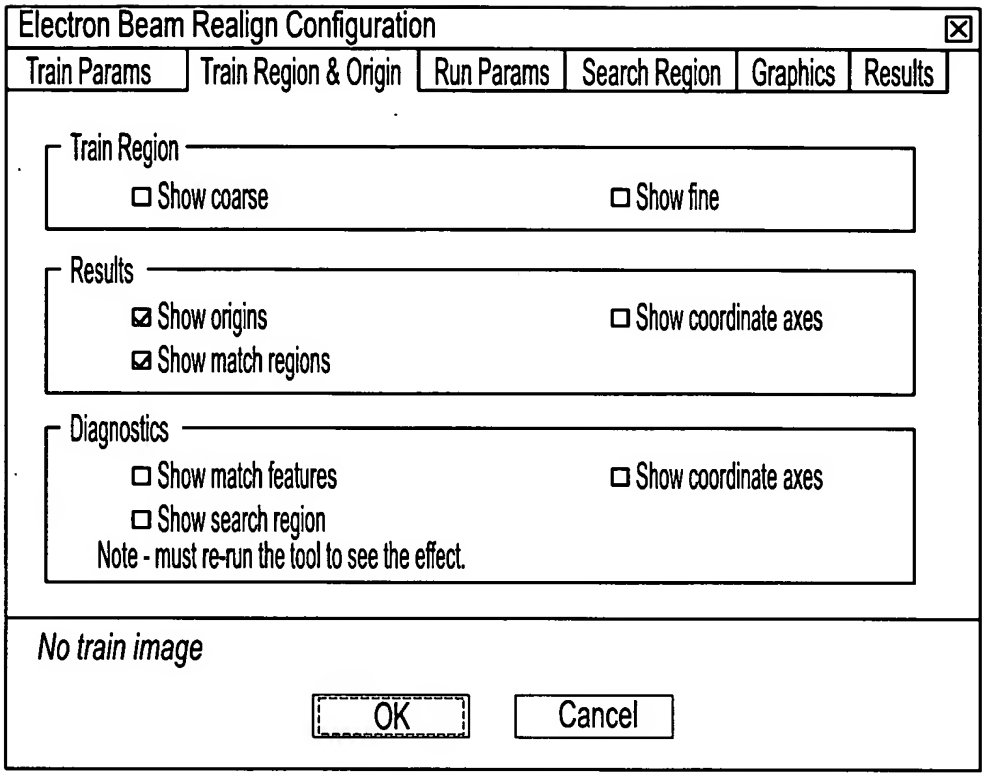

Electron Beam Realign Configuration
Train Params
Train Region & Origin
Run Params
Search Region
Graphics
Results
Train Region
Show coarse
Show fine
Results
Show origins
Show coordinate axes
Show match regions
Diagnostics
Show match features
Show coordinate axes
Show search region
Note - must re-run the tool to see the effect.
No train image
OK
Cancel

FIG. 10H

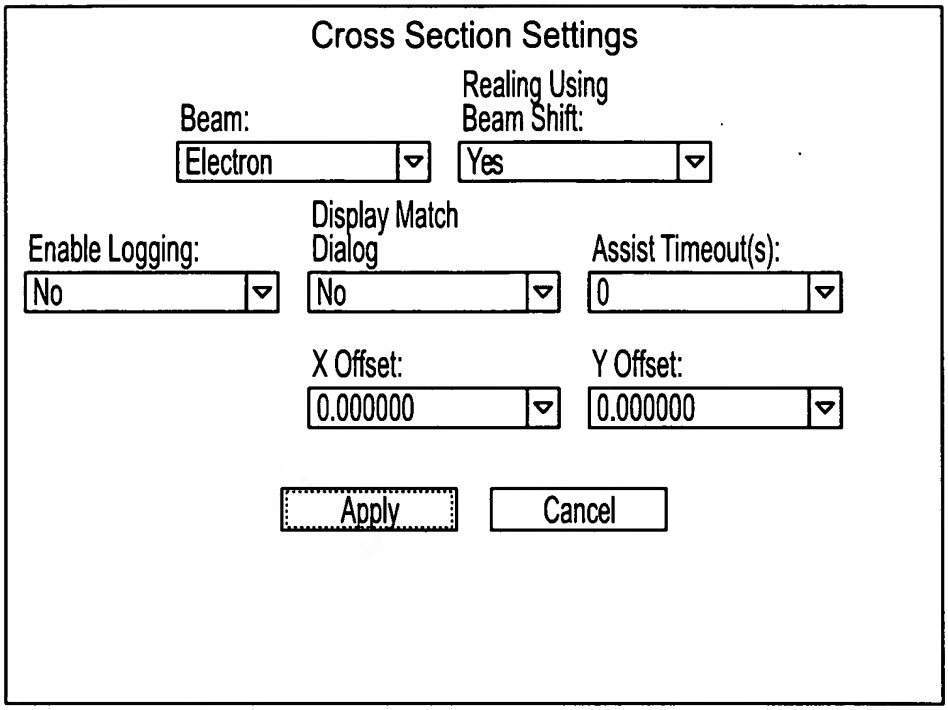

Cross Section Settings
Beam:
Electron
Realing Using Beam Shift:
Yes
Enable Logging:
No
Display Match Dialog
No
Assist Timeout(s):
0
X Offset:
0.000000
Y Offset:
0.000000
Apply
Cancel

FIG. 11A

Item	Description
Beam	Specifies the beam to be used in the alignment.
Realign Using Beam Shift	Specifies the type of alignment to be made. YES specifies an alignment made using beam shift. NO specifies an alignment made using a stage move. For best results, realign the electron beam with stage moves and the ion beam with beam shift.
Enable Logging	When this option is selected, the system logs the following information: Name and path of the image file used for realignment X location of the fiducial in pixels and microns Y location of the fiducial in pixels and microns If the fiducial is not found, the system writes "Fail" to the log file.
Display Match Dialog	Displays the Image Match dialogue (see "Image Match" on page 4-10)
Assist Timeout(s)	Number of seconds before a dialog box appears, prompting for user intervention. If this value is 0, no dialog box appears.
FOV Offset	Specifies a proportional shift of the field of view. When this option is selected, the system shifts the field of view by the proportion of the field of view specified in X and Y. When this portion is not selected, the system shifts the field of view by the distance in microns specified in X and Y.
X Offset, Y Offset	Specify the distance by which the system shifts the field of view during alignment. When FIELD OF VIEW is selected, the values specified in X and Y denote a portion of the field of view-e.g., a value of 0.1 equals 10% of the field of view. Acceptable values are 0-1. When FIELD OF VIEW is not selected, the system shifts the field of view by the distance in microns specified in X and Y.

FIG. 11B

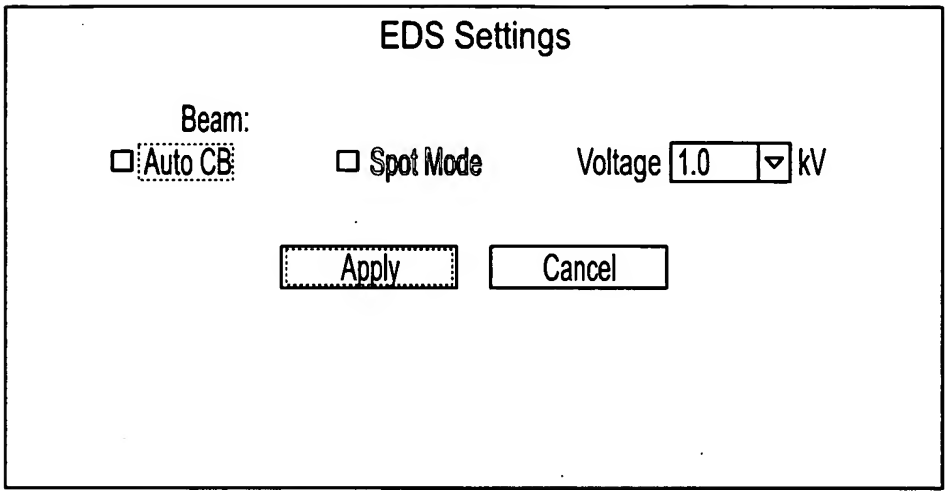


FIG. 12A

Item	Description
Auto CB	Performs automatic contrast and brightness
Spot Mode	Selects Spot as the scanning mode.
Voltage	Voltage to be used to acquire spectrum.

FIG. 12B

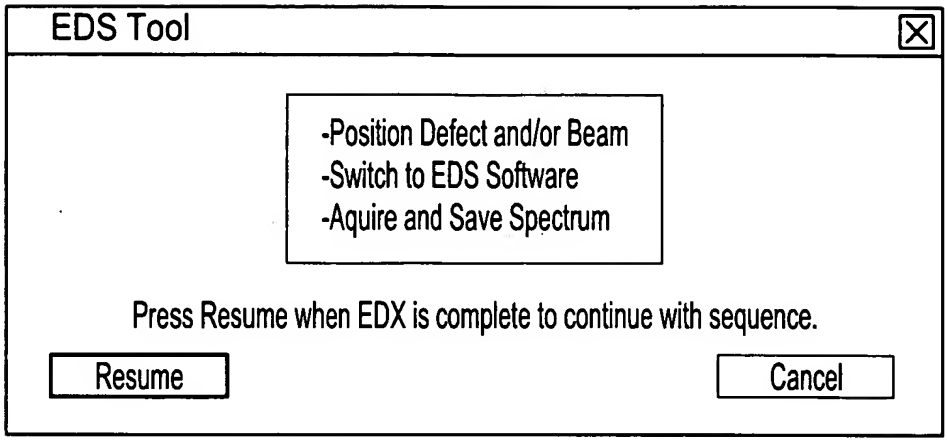


FIG. 12C

Interface items	Description
Resume	Associates the spectrum with the current site and continues automated processing.
Voltage	Does not put anything into the database and gives you the option to fail the site.

FIG. 12D

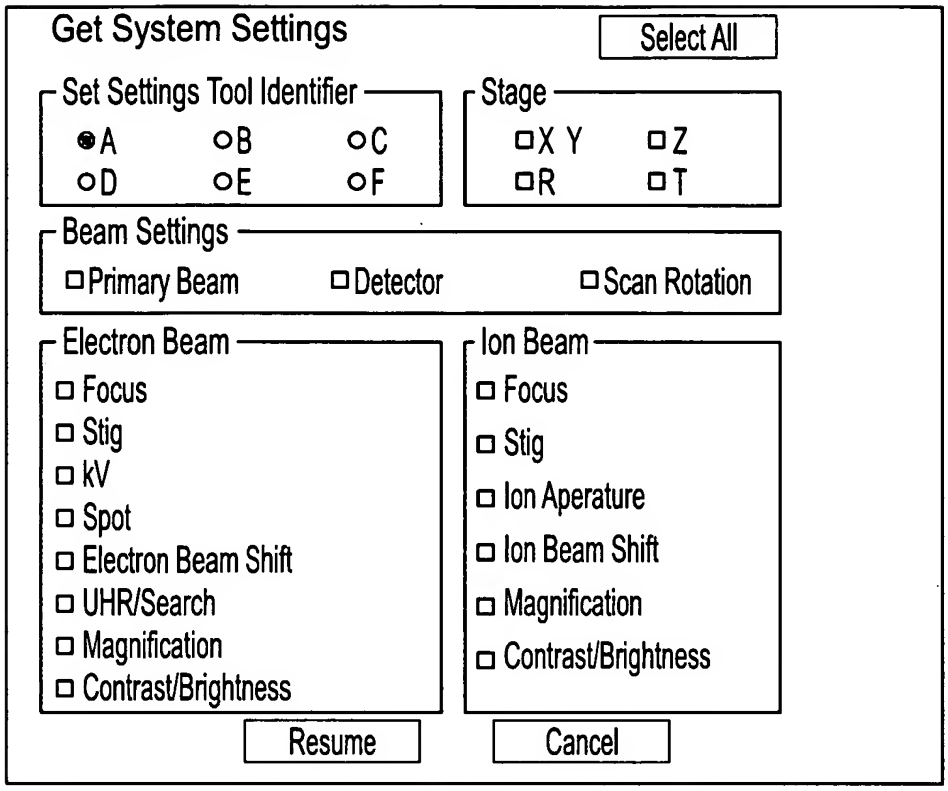


FIG. 13A

Item	Description
Select All/De-Select All	Selects or deselects every option in the Stage, Beam Settings, Electron Beam, and Ion Beam groups.
Set Settings Tool Identifier	Identifies a set of stored settings
Stage	Contains options for recording the positions of the five independent axes.
Beam Settings	Contains options for recording the following current beam settings.
Primary Beam	
Detector	
Scan Rotation	
Electron Beam	Contains options for recording the current electron beam parameters. Focus, Stigmation, Accelerating voltage (kV), Spot size, Beam shift, Mode (UHR or Search), Magnification, Contrast/Brightness
Ion Beam	Contains options for recording the current electron beam parameters. Focus, Stigmation, Apperatus, Beam shift, Magnification, Contrast/Brightness

FIG. 13B

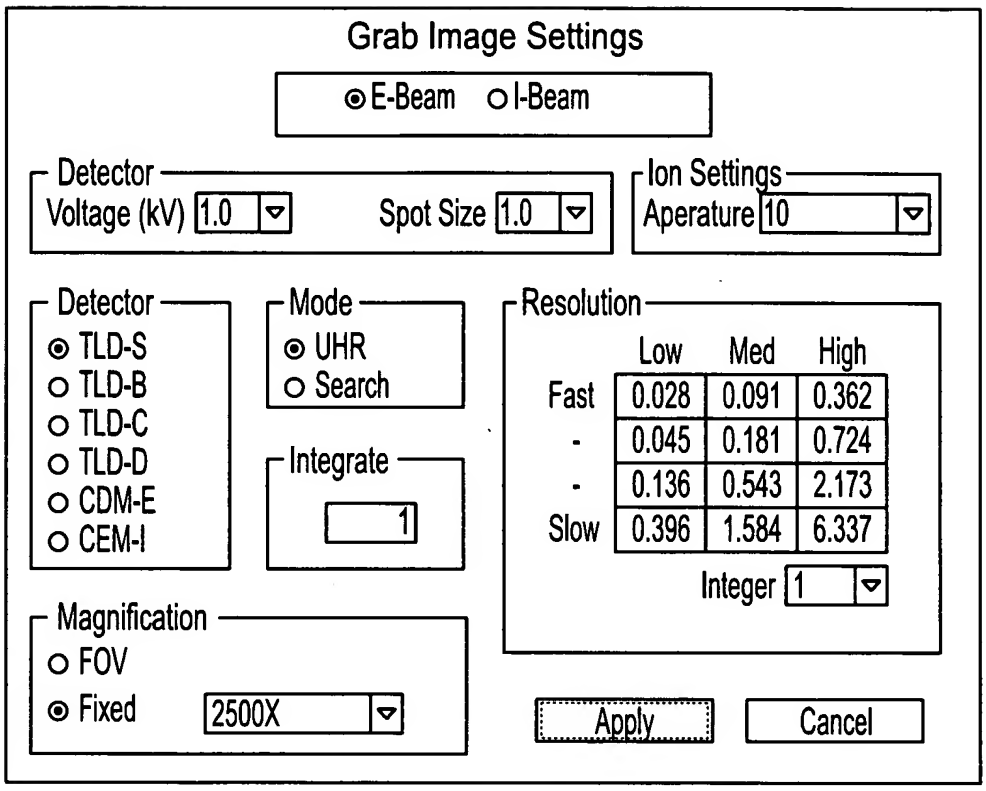

Grab Image Settings
E-Beam
I-Beam
Detector
Voltage (kV) 1.0
Spot Size 1.0
Ion Settings
Aperature 10
Detector
TLD-S
TLD-B
TLD-C
TLD-D
CDM-E
CEM-I
Mode
UHR
Search
Integrate
1
Resolution
Low Med High
Fast 0.028 0.091 0.362
- 0.045 0.181 0.724
- 0.136 0.543 2.173
Slow 0.396 1.584 6.337
Integer 1
Magnification
FOV
Fixed
2500X
Apply
Cancel

FIG. 13C

Item	Description
E-Beam	Use electron beam to grab an image.
I-Beam	Use ion beam to grab an image.
Electron Settings:	
Voltage (kV)	Active only for the electron beam. Specify the accelerating voltage.
Spot Size	Active only for the electron beam. Specify the spot size.
Detector	Select the detector used to collect the image. Available selections are dependent on the selected mode and beam. Refer to the xP DualBeam Workstation User's Guide (PN 25417) for information about detector types.
Mode	Active only for the electron beam. Select Search mode for low magnifications and UHR mode for higher magnifications.
Image:	
ACB	Automatically adjusts contrast and brightness using the stored values for comparison.
AutoFocus	Automatically corrects the focus, based on the system sharpness criteria.
AutoStig	Automatically corrects sigmatism, based on the system sharpness criteria. Available for the electron beam.
Data Bar	Save the databar as seen into the image.
Magnification	Specifies the magnification used to grab the image. Select either the field-of-view(determined by the Fiducial tool) or choose from a range of preset magnifications.
Ion Aperture	Active only for the ion beam. Sets the ion aperture.
Resolution	Selects the scan rate and resolution for grabbing a single frame. The values are those available for Grab Image.
Integrate	Specifies the number of collected images to be summed to generate the final image.

FIG. 13D

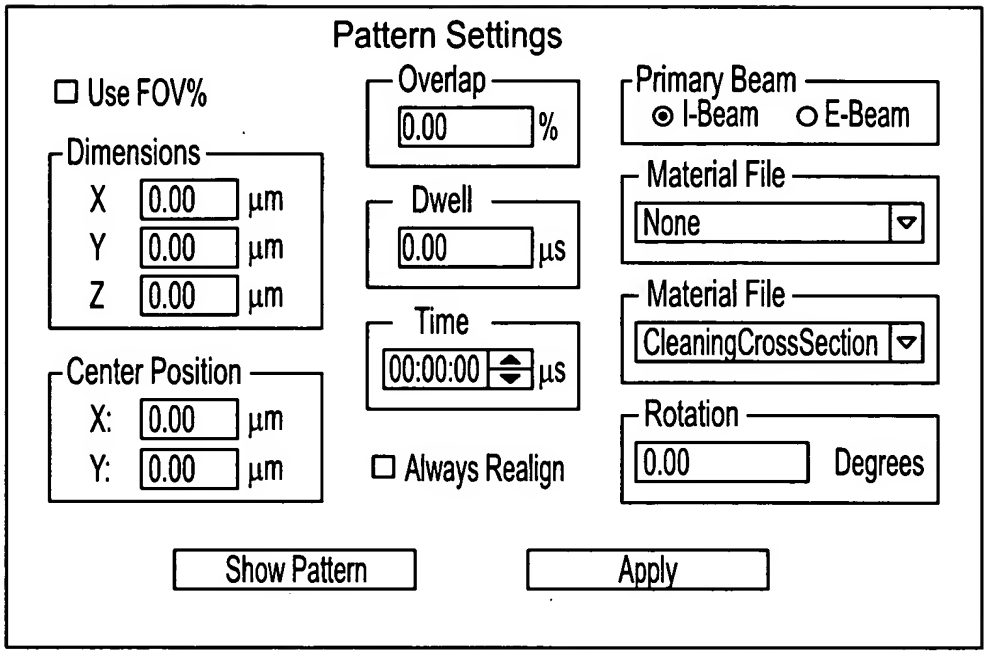

Pattern Settings
Use FOV%
Dimensions
X 0.00 µm
Y 0.00 µm
Z 0.00 µm
Center Position
X: 0.00 µm
Y: 0.00 µm
Overlap
0.00 %
Dwell
0.00 µs
Time
00:00:00 µs
Always Realign
Primary Beam
I-Beam
E-Beam
Material File
None
Material File
CleaningCrossSection
Rotation
0.00 Degrees
Show Pattern
Apply

FIG. 14A

Item	Description
Use FOV%	Converts X and Y coordinates in Dimensions and Center Position to a percentage of the field of view When this option is selected X and Y coordinates in Dimensions and Center Position denote a percentage of the field of view. When this option is not selected, X and Y coordinates in Dimensions and Center Position are in microns.
Dimensions	Sets the X, Y, and Z pattern dimensions. When Pattern Type is set to Circle, X and Y are replaced by Rin (inner radius) and Rout (outer radius)
Center Position	Shows the stage X and Y coordinates of the center of the pattern relative to the center of the field of view.
Overlap	Beam overlap. Not available when a material file is selected.
Dwell	Dwell time per pixel. Not available when a material file is selected.
Time	Time for milling displayed as either hh:mm:ss or ss:ttt.
Always Realign	When this portion is selected, the system always realigns to the fiducial mark before milling the specified pattern. When this option is selected, the system only realigns to the fiducial mark when an aperture has changed or a GIS needle has been inserted.
Show Pattern/Remove Pattern	Displays the currently defined pattern. When a pattern is already on screen, removes that pattern
Primary Beam	Select I-Beam or E-BEAM as the beam that will be used for patterning
Material File	Select the material file for your application. Refer to the xP DualBeam Workstation User's Guide (PN 25417) for information about material files.
Pattern Type	Defines the pattern. Refer to the xP DualBeam Workstation User's Guide (PN 25417) for information about available patterns.
Rotation	Rotates the pattern about its center to the specified angle.

FIG. 14B

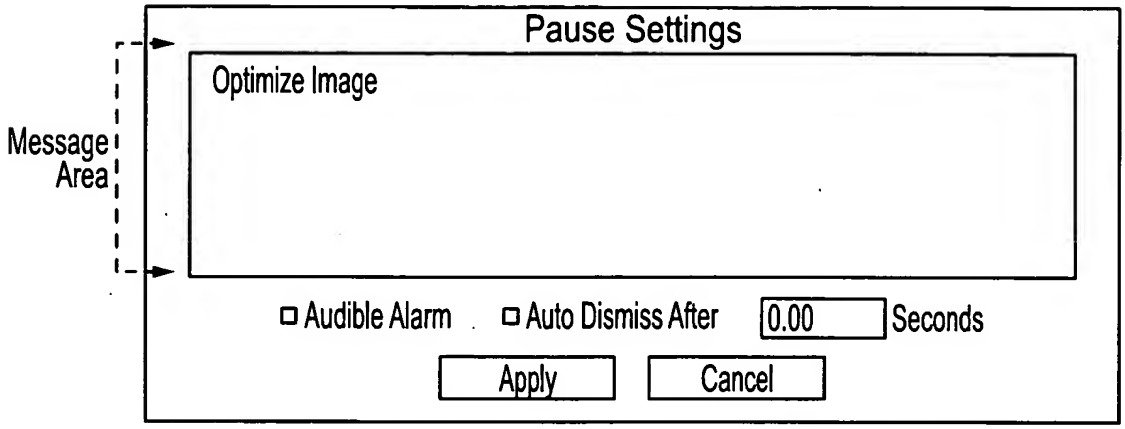


FIG. 15A

Item	Description
Message area	Defines actions the user should take before continuing processing.
Audible alarm	Cause an alarm to sound when the Pause dialog box displays during a job.
Auto dismiss	Selects if the Pause dialog box should time out. Otherwise, the Pause dialog box must be manually dismissed. The number of seconds specifies the fixed amount of time Pause dialog box is displayed during a job.

FIG. 15B

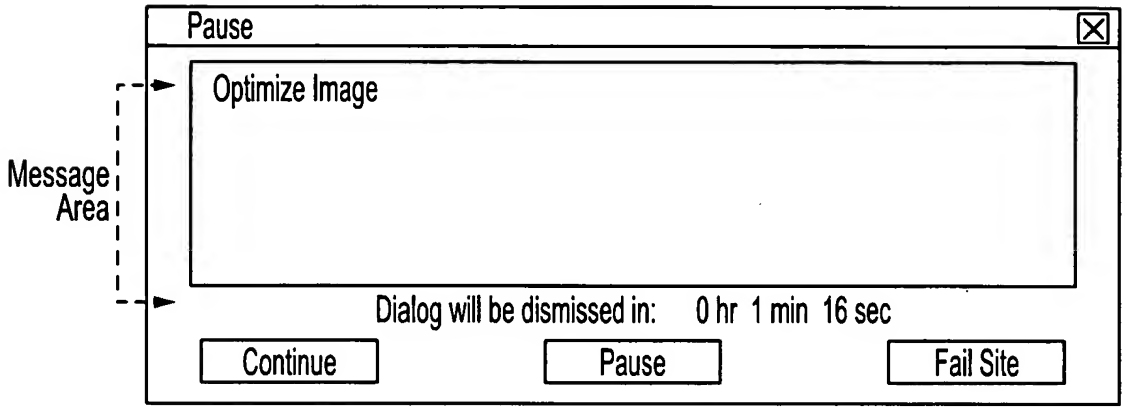


FIG. 15C

Item	Description
Message area	Defines action operator should take before proceeding with the process. The text cannot be modified during runtime.
Timeout clock	The time the dialog box will be displayed during a job. If the operator does not interact with the tool, the Pause dialog box times out as specified and the process automatically continues.
Continue	Click to continue processing the current site. The site list grid will show that the site passed.
Pause/Resume	Stop/restarts the timer. (This button is inactive if AUTO DISMISS was not selected during configuration.) The process waits for the operator to click either CONTINUE or FAIL.
Fail Site	Click to fail the current site. Further processing at the site is aborted. Processing starts at the next site. The site list grid will show that the site failed. If the entire job is to be aborted, the operator can click ABORT in the Run Tool Sequence dialog box

FIG. 15D

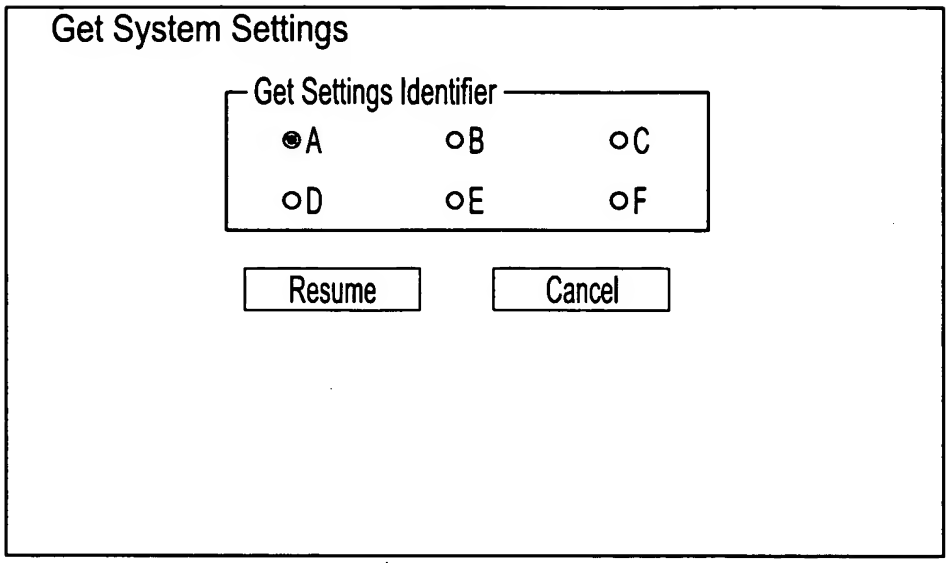


FIG. 16

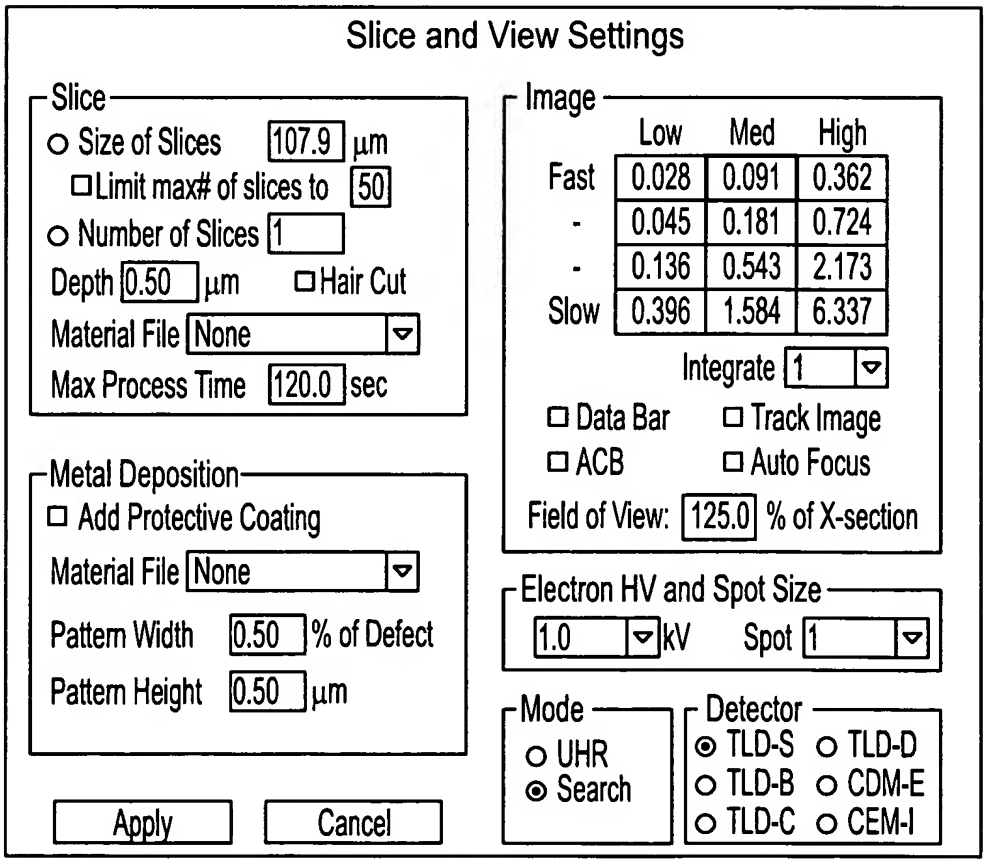


FIG. 17A

Item	Description
Slice:	User selects either SIZE OF SLICES or NUMBER OF SLICES.
Size of Slices	Specifies the slice size in microns. The number of slices to be milled will be calculated by dividing the size of the defect (determined by fiducial tool) by the size of the slices.
Limit max # of slices to	The Maximum number of slices to be made in the Slice and View area.
Number of Slices	Specifies the number of slices to be milled. The height of each slice is determined by the software dividing the value specified for height (y) by the number of slices. Where is height from? A maximum of 100 individual patterns can be displayed. If the tool calls for more than 100 slices, an outline indicating the overall area to be sliced is displayed.
Depth	Specifies the pattern depth in microns.
Half Cut	Mills only half way through the defect selected (up to the center cross).
Material File	Displays a dropdown list of selecting a material file (.mtr). The list contains an entry for every material file available on the system. The default material file is si.mtr.
Max Process Time	The Maximum time process may occur
Metal Deposition:	
Add Protective Costing	If this option is selected, a protective layer will be centered about the Slice and View area. The scale will be set in the job builder configuration and based upon the size of the slice and view area. If protective coating is not selected, the fields associated with it should be inactive.
Material File	Displays a dropdown list for selecting a material file (.mtr). The list contains an entry for every material file available on the system. the default material file is either pt_high mtr.
Pattern Width	Specifies the pattern width, as a percentage of the defect size.
Pattern Height	Specifies the pattern height, in microns.
Image:	
Scan Speed Matrix	Sets the frame time and resolution used for the electron beam images of the cross-section face. These values correspond generally to the faster continuous scan rates available in xP. Refer to the xP DualBeam Workstation User's Guide for information about the available resolutions.
Integrate	Number of frames to integrate for accumulative noise reductions.
Data Bar	Includes the databar configured in xP in the image.
ACB	Selects automatically adjusting contrast and brightness, using the stored values for comparison.
Track Image	Adjusts the electron beam shaft to keep the face of the cross section centered in the field of view.
Auto Focus	Initiates automated focus before the system begins capturing electron beam images.
Field of View	Specifies the field of view used for electron beam images of the cross-section face, as a percentage of the cross-section.
Electron HV and Spotsize:	kV specifies the electron beam accelerating voltage, Select from the range of voltages available for the currently selected imaging mode. SPOTSIZE specifies the actual focused area of the electron beam on the sample.
Mode	Select UHR or Search as the imaging mode..
Detector	Select the detector to be used for the electron beam images. Choices are determined by the currently selected imaging mode.

FIG. 17B

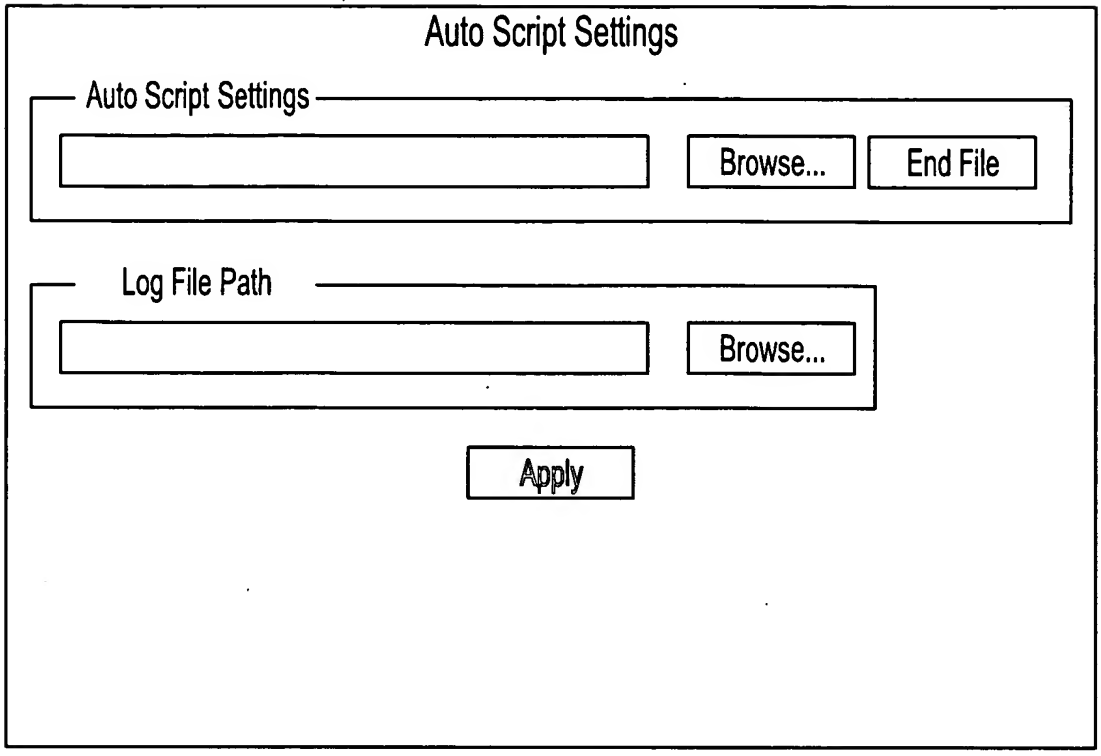


FIG. 18A

Item	Description
Script File Path	Name and path of the AutoScript file.
Browser	Accesses the Open dialog box so you can navigate to a script file.
Edit File	Opens the selected script file in the Windows Notepad text editor.
Log File Path	Name and path of the log file.
Browse	Accesses the Open dialog box so you can navigate to the log file.

FIG. 18B

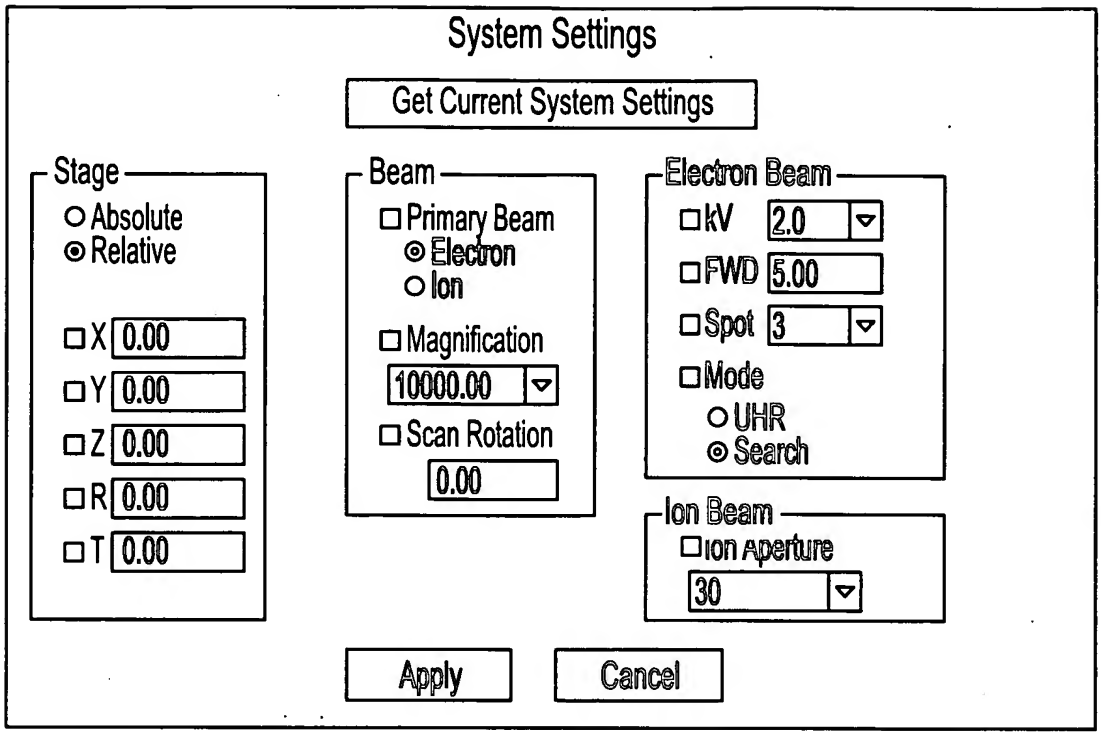


FIG. 19A

Item	Description
Get Current System Setting	Gets the current system settings for all options.
Stage:	
Absolute	Chooses coordinates measured from the center of the stage.
Relative	Chooses coordinates measured from the current location on the stage
X,Y,Z,R,T	Sets the positions of the five independent axes.
Beam:	
Primary Beam	Sets the icon beam or electron beam as the primary beam. The selected beam sets the magnification and other image data of the current image window.
Magnification	Sets magnification to the specified value.
Scan Rotation	Sets scan rotation to the specified value.
Electron Beam:	Sets scan rotation to the specified value.
kV FWD Spot Mode **Ion Beam:**	Sets the accelerating voltage for the electron beam. Choose a value from the adjacent dropdown list. Sets the electron beam focus to the free working distance specified in the adjacent edit box. Sets the aperture size for the electron beam. Choose a value from the adjacent dropdown box. Selects the mode for the electron beam.
Ion Aperture	Sets the ion beam current to the aperture (inpA) specified in the adjacent dropdown list.

FIG. 19B

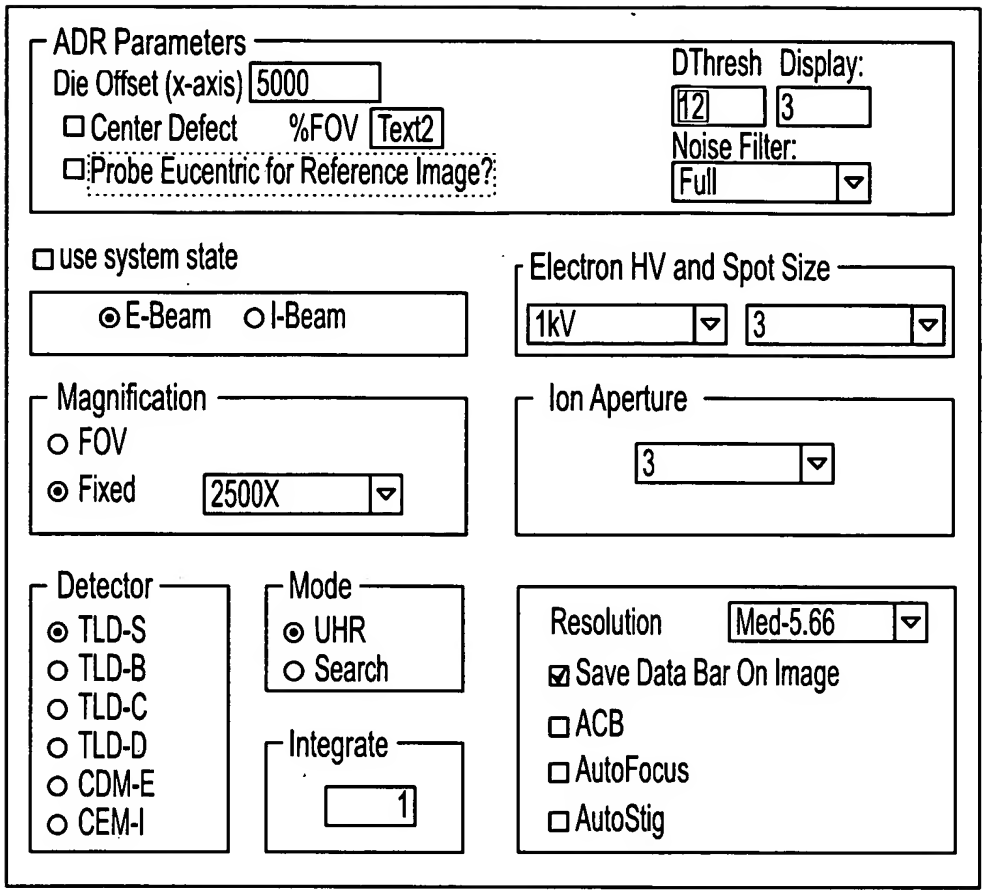

ADR Parameters
Die Offset (x-axis) 5000
Center Defect %FOV Text2
Probe Eucentric for Reference Image?
DThresh Display:
12
3
Noise Filter:
Full
use system state
E-Beam
I-Beam
Electron HV and Spot Size
1kV
3
Magnification
FOV
Fixed
2500X
Ion Aperture
3
Detector
TLD-S
TLD-B
TLD-C
TLD-D
CDM-E
CEM-I
Mode
UHR
Search
Integrate
1
Resolution
Med-5.66
Save Data Bar On Image
ACB
AutoFocus
AutoStig

FIG. 20A

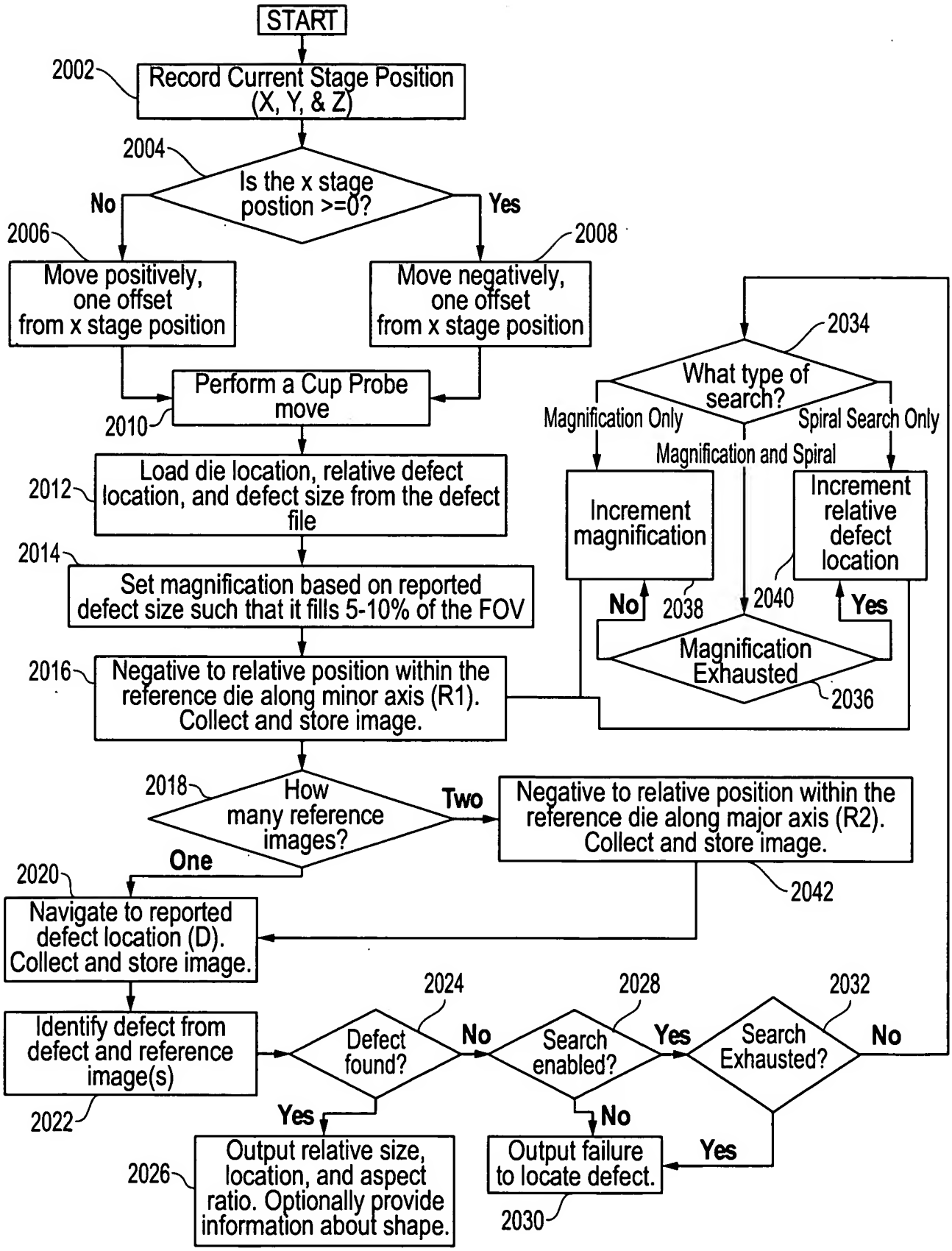

START
2002
Record Current Stage Position (X, Y, & Z)
2004
Is the x stage postion >=0?
No
Yes
2006
Move positively, one offset from x stage position
2008
Move negatively, one offset from x stage position
Perform a Cup Probe move
2010
Load die location, relative defect location, and defect size from the defect file
2012
Set magnification based on reported defect size such that it fills 5-10% of the FOV
2014
Negative to relative position within the reference die along minor axis (R1). Collect and store image.
2016
How many reference images?
2018
Two
One
Negative to relative position within the reference die along major axis (R2). Collect and store image.
2042
Navigate to reported defect location (D). Collect and store image.
2020
Identify defect from defect and reference image(s)
2022
Defect found?
2024
No
Yes
Search enabled?
2028
Yes
No
Search Exhausted?
2032
No
Yes
Output relative size, location, and aspect ratio. Optionally provide information about shape.
2026
Output failure to locate defect.
2030
What type of search?
2034
Magnification Only
Spiral Search Only
Magnification and Spiral
Increment magnification
Increment relative defect location
No
2038
2040
Yes
Magnification Exhausted
2036

FIG. 20B

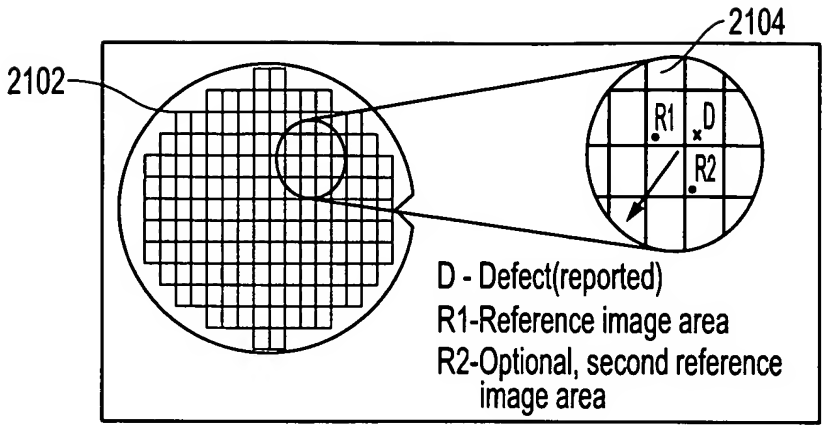


FIG. 21

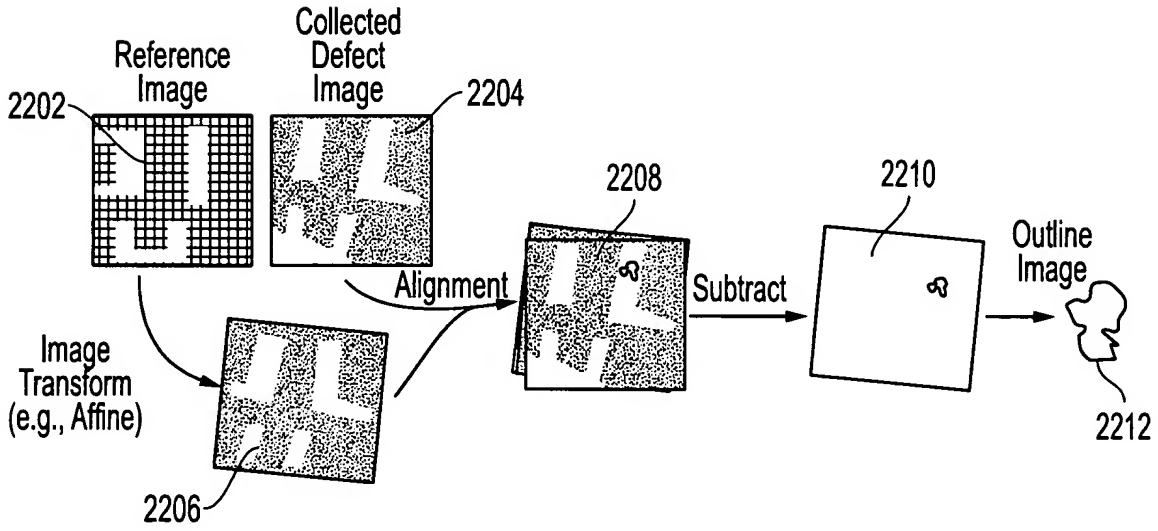


FIG. 22

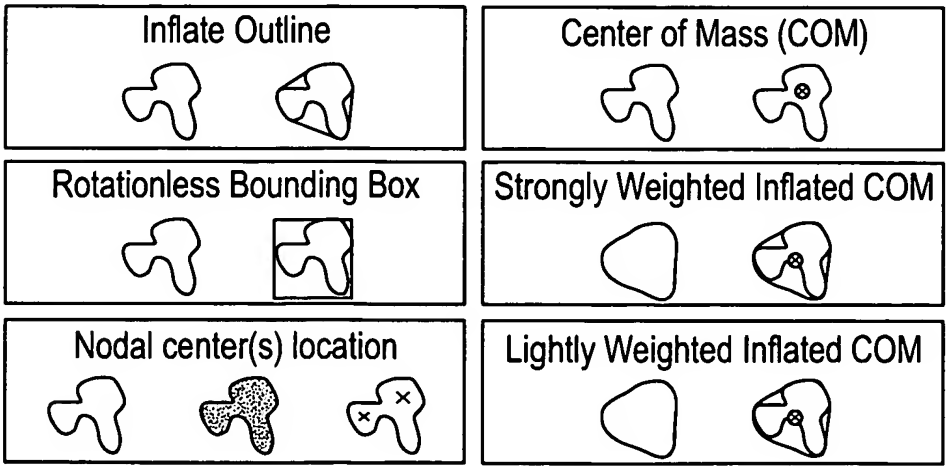


FIG. 23A

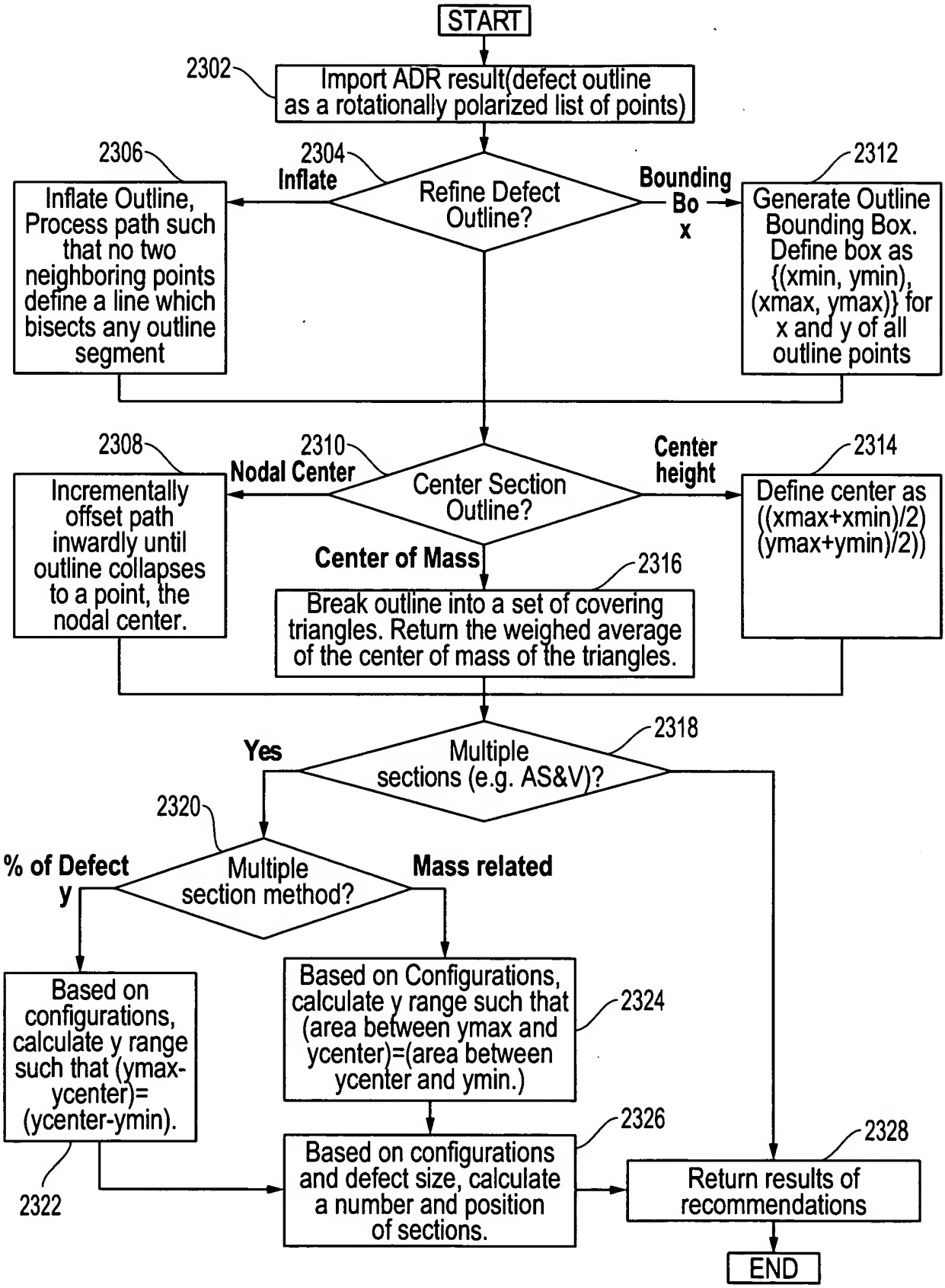

START
2302
Import ADR result(defect outline as a rotationally polarized list of points)
2304
Refine Defect Outline?
Inflate
Bounding Box
2306
Inflate Outline, Process path such that no two neighboring points define a line which bisects any outline segment
2312
Generate Outline Bounding Box. Define box as {(xmin, ymin), (xmax, ymax)} for x and y of all outline points
2308
Incrementally offset path inwardly until outline collapses to a point, the nodal center.
2310
Center Section Outline?
Nodal Center
Center height
Center of Mass
2314
Define center as ((xmax+xmin)/2) (ymax+ymin)/2))
2316
Break outline into a set of covering triangles. Return the weighed average of the center of mass of the triangles.
2318
Multiple sections (e.g. AS&V)?
Yes
2320
Multiple section method?
% of Defect y
Mass related
Based on configurations, calculate y range such that (ymax-ycenter)=(ycenter-ymin).
Based on Configurations, calculate y range such that (area between ymax and ycenter)=(area between ycenter and ymin.)
2324
2322
2326
Based on configurations and defect size, calculate a number and position of sections.
2328
Return results of recommendations
END

FIG. 23B

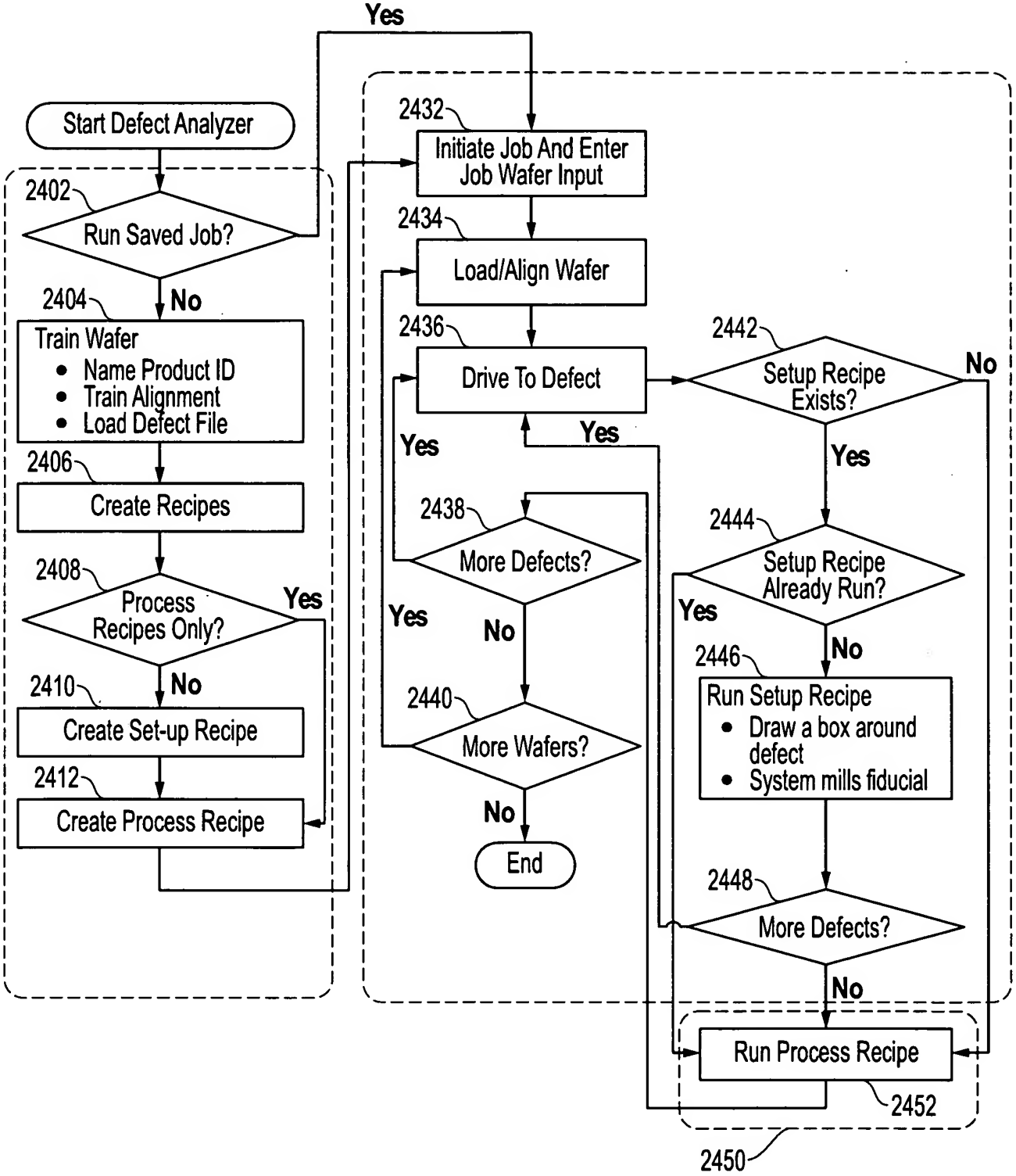

Start Defect Analyzer
2402
Run Saved Job?
Yes
No
2404
Train Wafer
• Name Product ID
• Train Alignment
• Load Defect File
2406
Create Recipes
2408
Process Recipes Only?
Yes
No
2410
Create Set-up Recipe
2412
Create Process Recipe
2432
Initiate Job And Enter Job Wafer Input
2434
Load/Align Wafer
2436
Drive To Defect
2438
More Defects?
Yes
No
2440
More Wafers?
Yes
No
End
2442
Setup Recipe Exists?
Yes
No
2444
Setup Recipe Already Run?
Yes
No
2446
Run Setup Recipe
• Draw a box around defect
• System mills fiducial
2448
More Defects?
Yes
No
Run Process Recipe
2452
2450

FIG. 24

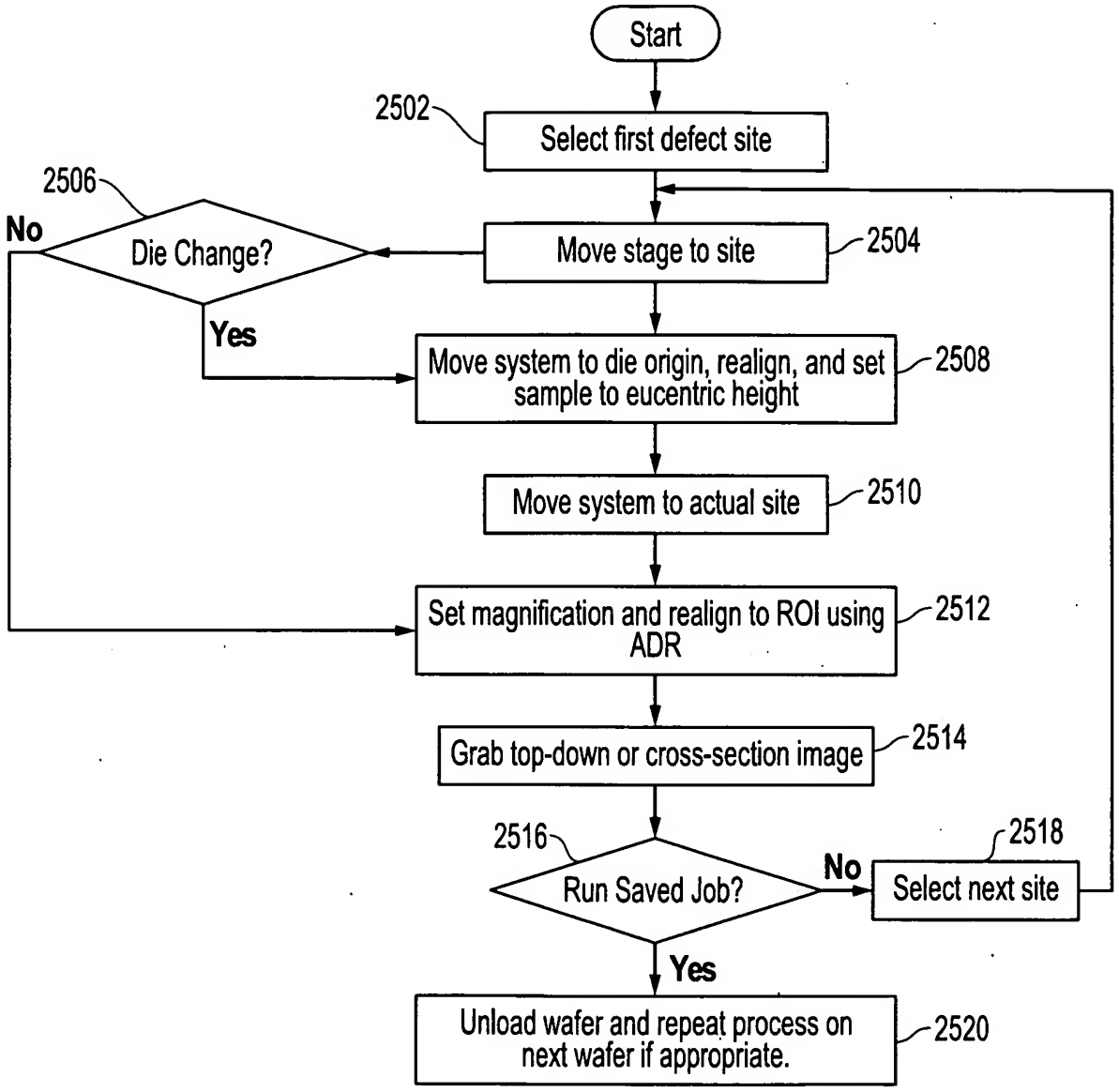

Start
2502
Select first defect site
2506
No
Die Change?
Yes
Move stage to site
2504
Move system to die origin, realign, and set sample to eucentric height
2508
Move system to actual site
2510
Set magnification and realign to ROI using ADR
2512
Grab top-down or cross-section image
2514
2516
Run Saved Job?
No
2518
Select next site
Yes
Unload wafer and repeat process on next wafer if appropriate.
2520

FIG. 25

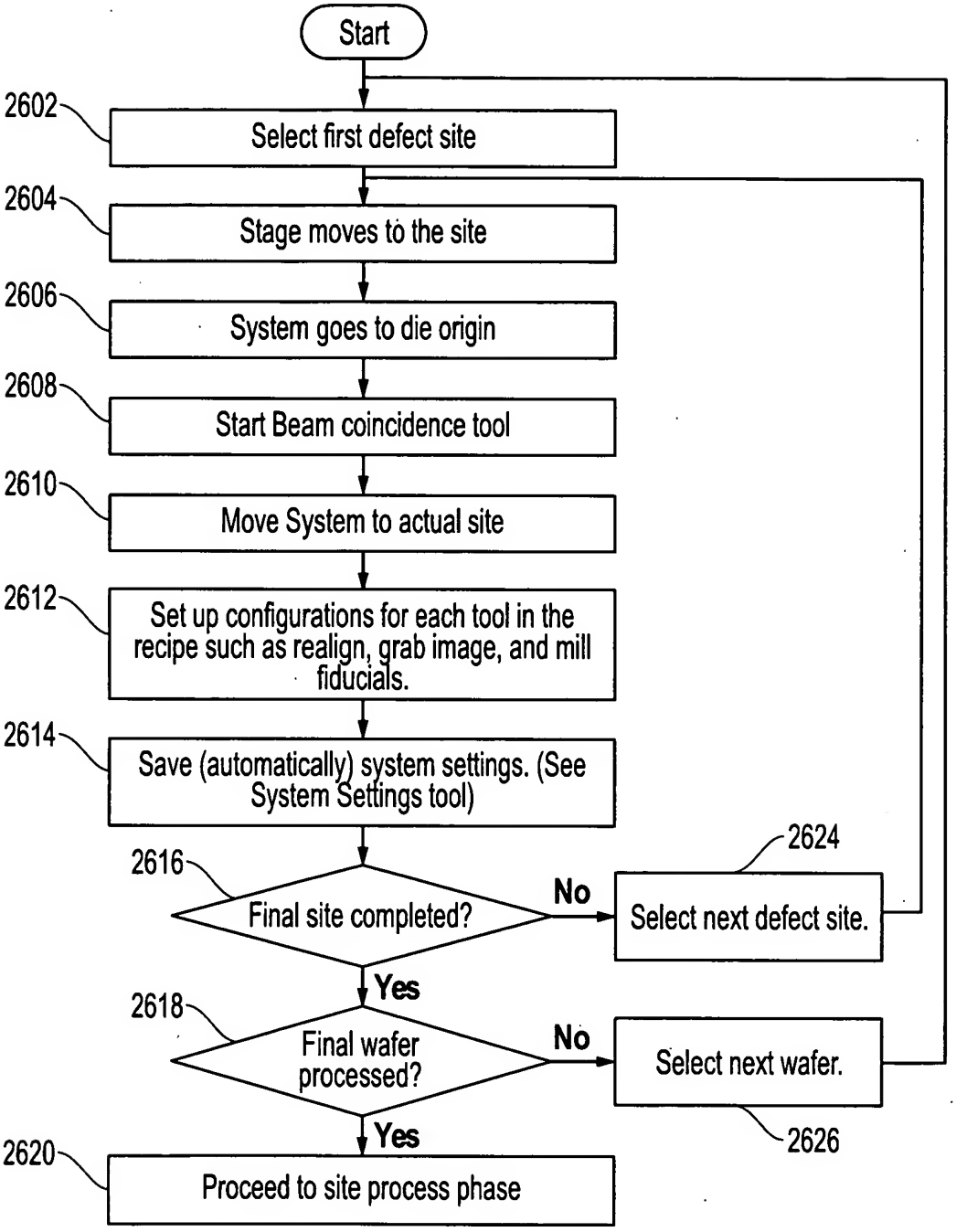

Start
2602
Select first defect site
2604
Stage moves to the site
2606
System goes to die origin
2608
Start Beam coincidence tool
2610
Move System to actual site
2612
Set up configurations for each tool in the recipe such as realign, grab image, and mill fiducials.
2614
Save (automatically) system settings. (See System Settings tool)
2616
Final site completed?
No
2624
Select next defect site.
Yes
2618
Final wafer processed?
No
Select next wafer.
2626
Yes
2620
Proceed to site process phase

FIG. 26A

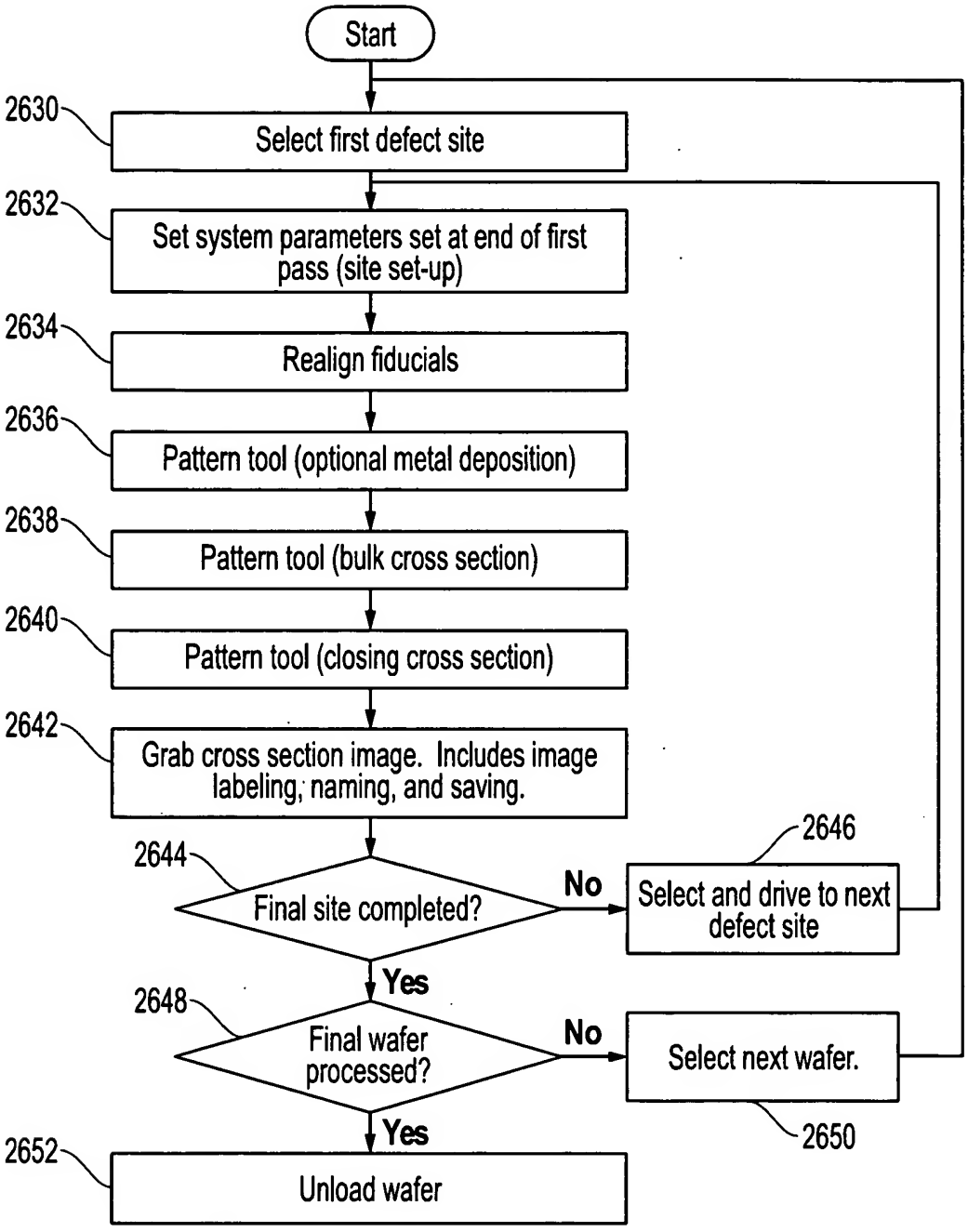

Start
2630
Select first defect site
2632
Set system parameters set at end of first pass (site set-up)
2634
Realign fiducials
2636
Pattern tool (optional metal deposition)
2638
Pattern tool (bulk cross section)
2640
Pattern tool (closing cross section)
2642
Grab cross section image. Includes image labeling, naming, and saving.
2644
Final site completed?
No
2646
Select and drive to next defect site
Yes
2648
Final wafer processed?
No
Select next wafer.
2650
Yes
2652
Unload wafer

FIG. 26B

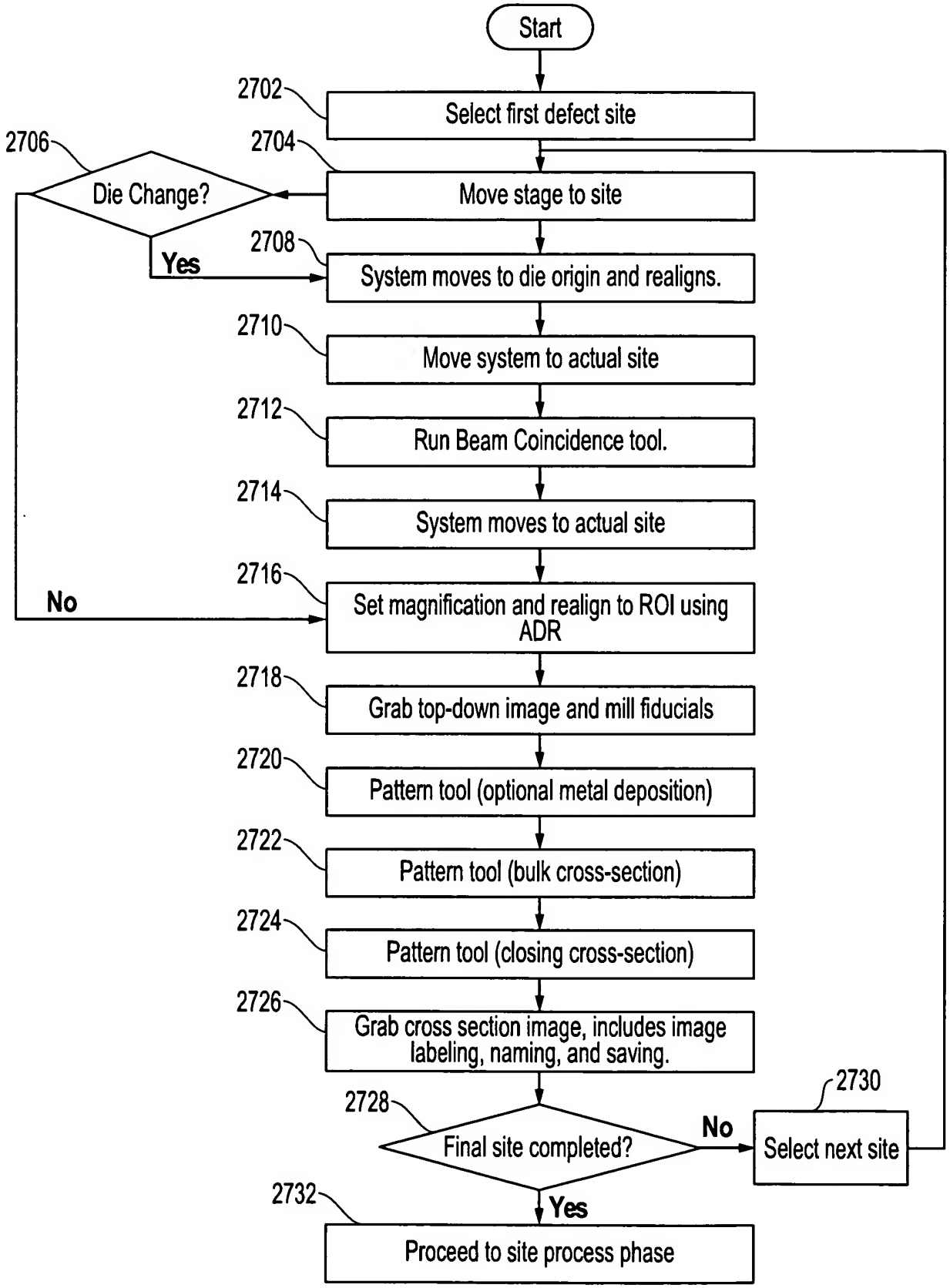

Start
2702
Select first defect site
2706
Die Change?
2704
Move stage to site
Yes
2708
System moves to die origin and realigns.
2710
Move system to actual site
2712
Run Beam Coincidence tool.
2714
System moves to actual site
2716
No
Set magnification and realign to ROI using ADR
2718
Grab top-down image and mill fiducials
2720
Pattern tool (optional metal deposition)
2722
Pattern tool (bulk cross-section)
2724
Pattern tool (closing cross-section)
2726
Grab cross section image, includes image labeling, naming, and saving.
2730
2728
Final site completed?
No
Select next site
Yes
2732
Proceed to site process phase

FIG. 27